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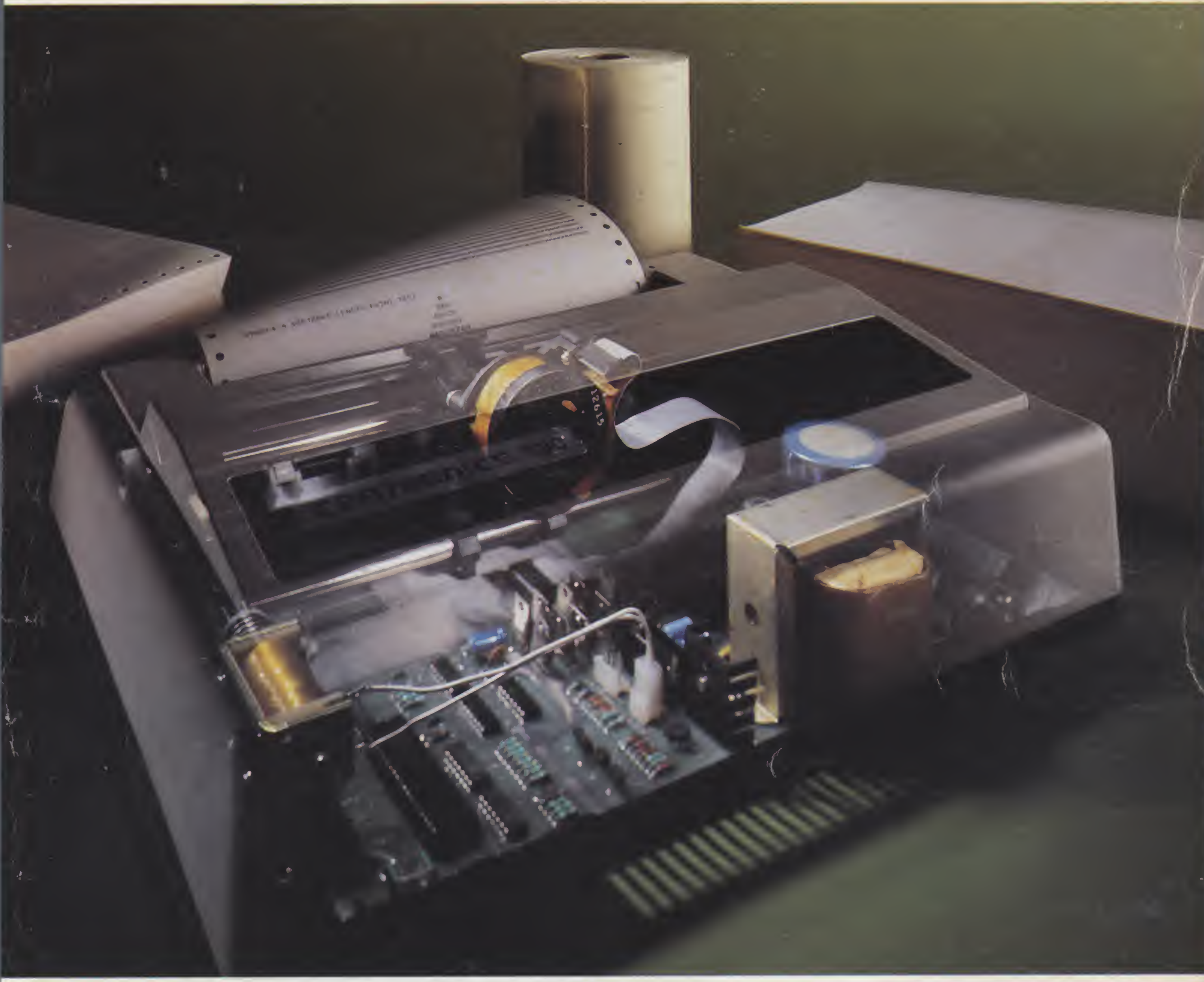

In This Issue:

Plus diagnostic aids, computer blackjack and much more.

Complete contents on page 4.

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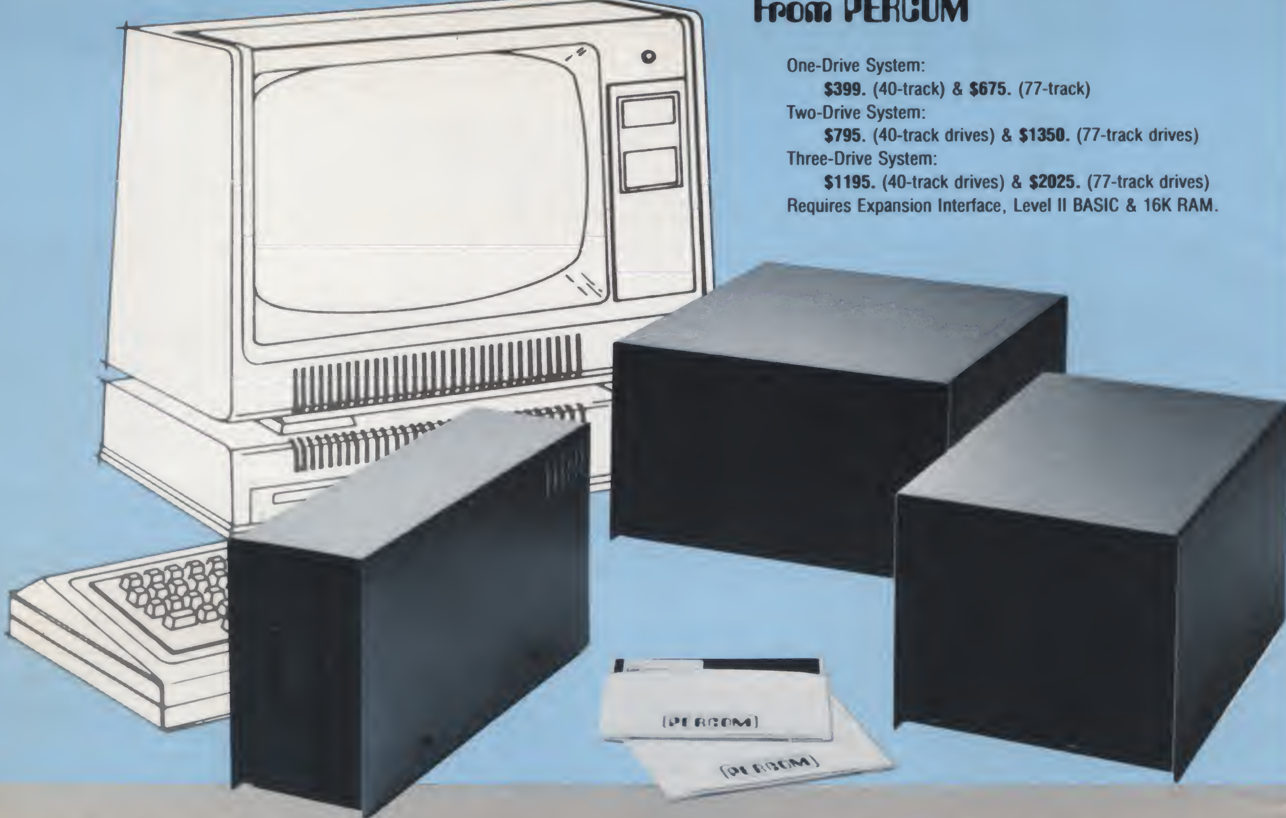

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Your operators will praise the SuperBrain's good looks. A full ASCII keyboard with a numeric keypad and function keys. A non-glare, dynamically focused, twelve inch screen. All in an attractive desktop unit weighing less than a standard office typewriter. Sophisticated users will acclaim SuperBrain's twin Z-80 processors which transfer data to the screen at 38 kilobaud! Interfacing a printer or modem is no problem using SuperBrain's RS-232C communications port. But best of all, you won't need a PhD in computer repair to maintain the SuperBrain. Its single board design makes servicing a snap!

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CONTENTS

Microcomputing, September 1979

PUBLISHER'S REMARKS

Wayne Green

Microcomputing in Italy

While walking through downtown Florence, Sherry spotted a poster on a building wall showing an article on microcomputing in an Italian science magazine. We immediately bought a copy of the magazine and noted that the major distributor of microcomputers in Italy is Homic, out of Milan.

A few days later, when we reached Milan, we took the subway out to the area indicated in the address and eventually found Homic. We were received with enthusiasm, which even included a free lunch . . . not a small matter in Italy. Homic is the importer of the TRS-80, the PET, the SWTP and others. I think Homic is the *only* microcomputer importer for Italy. There are just a few stores selling microcomputers in Italy, so the field is just starting there.

One result of the visit was our determination to quickly begin translating Instant Software programs into Italian as a way of supporting the sale of microcomputers in Italy. While many Germans are familiar with English, the percentage of Italians who can use English programs is very small. Fortunately, we have an Italian working in Instant Software, Piergiorgio Saluti, from Ascoli Piceno, a small town near San Marino. Giorgio is running the Instant Software art department, and now is also busy translating both the programs and the instructions for them into Italian. Watch out, Italy!

In addition to the fine article on microcomputers in the science magazine, there have also been excellent articles in the hi-fi magazines and others. Homic is doing a first-rate job of getting microcomputers into the public eye in Italy.

On the other hand, if you think you have trouble with service on your microcomputer, perhaps you can picture the problems in Italy. You don't just mail back a bum unit, not with all the customs paperwork and delays. You have little choice but to sit down and fix it yourself; considering the lack of service information and diagnostic programs, this is a major problem.

In Seine Prices

How expensive can Paris be? Ask Bernard Silverman, the director of marketing for North Star. He innocently asked Sherry and me out to lunch during the Paris microcomputer Expo. The sign by the elevator in the Palais des Congres, where the show was running, indicated that the restaurants were on the 7th floor. We elevated and walked into the first restaurant we spotted. It

Reader Responsibility

One of your responsibilities, as a reader of *Kilobaud MICROCOMPUTING*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud MICROCOMPUTING*. Remember: Subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in reader requests for information. To make it more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud MICROCOMPUTING*!

This month's winner of a lifetime subscription to *Microcomputing* is Oliver Hoheisel of El Paso TX.

looked like a nice one.

It was.

The name of the restaurant was L'etoile d'or, "The Golden Star," and it most surely was, at least for the restaurant. The three of us had a salad and a dessert, plus a Perrier and two coffees. The "addition" for this sparse repast—and at the price it could not be considered just a meal—was $47. What would a full lunch have cost?

In Paris

Left to right in the accompanying photo we see Reinhard Nedela, the European Manager for *Kilobaud Microcomputing* and Instant Software. Mr. Nedela is based in Markdorf on Bodensee in southern West Germany. He was the man behind the big microcomputer show in Munich last November.

Next is Mr. Pelissolo, the head of computer, electronic and aerospace industries for France. In the center is Rodnay Zaks, the president of Sybex and the organizer of the MICRO/EXPO in Paris. Rodnay is explaining about *Microcomputing* and Instant Software while I modestly doze off for a few moments. On the right is Sherry Smythe, head of Instant Software.

The Expo this year drew almost 10,000, and every one of them was a good prospect for most of the exhibitors. This has come to be the top microcomputer exposition in Europe.

Diagnostics Needed

Since most manufacturers seem to feel that their best diagnostic programs are proprietary (they won't disclose them), there is a growing need for such programs, and I think they will sell very well. They are needed for just about all popular systems, so get going. I'd be surprised if every publisher of programs wouldn't be delighted to get diagnostics to market; I know Instant Software would.

They Can Talk—But Can They Listen?

There are several ear systems for microcomputers, but precious little data on how well they work. I'm sure that we'd all be interested in an evaluation of the Heuristics system, the Lomac system and any other gadgets that will let our computers decipher speech.

As far as I've heard, the best of the speech-input systems are fragile and very limited in vocabulary. Of course, since the actual need for this function seems limited, I haven't given it as much consideration as I might otherwise. I can see where it would be handy for someone making an inventory count . . . perhaps using a cassette recorder to enter a list of the parts numbers and the quantities. This could speed up an inventory-management system. The computer would have to recognize ten numbers and perhaps a few letters or words. It could work if it would dependably sort out just the numbers.

How about it?

Making Money

Since my section in the June editorial about making money brought in a great many enthusiastic responses, I'll continue.

The key to making money in our country lies primarily in building your own small business. Oh, a few people have lucked into money. Some have married it (I know of no one who has done this with happy results, and I know chaps who thought they had it made when they married a rich gal). Some have stolen it (and I know one of these all too well). But in the long run, if you want to aim at making more than average money, you want to play the best odds.

How many people get rich working for the government? How many make it working for a big company? How many in education? Virtually none for any of these, if that tells you anything. No, the key to success these days lies in learning some small business and then starting your own.

Drawing on my own experience . . . I started out in 1951 writing and publishing a small monthly newsletter for amateur-radio Teletype enthusiasts. That escalated to a column on RTTY in *CQ* magazine, and that led to my becoming the editor of *CQ* in 1955. Five years later, *CQ* made one of the biggest mistakes of their history when they fired me, leaving me with nothing to do but start my own ham magazine: *73*. I should have quit *CQ* at least three years earlier and started a magazine, but it sure is difficult to make a break with that weekly paycheck—isn't it?

Once you know how to start a magazine you know how to generate a valuable property out of virtually nothing . . . for a profitable magazine can bring in well over $1 million in a year. A good example of this can be illustrated by the way I started *Byte* magazine back in 1975.

This Month's Cover

Using double-exposure techniques, photographer Steve Grohe of Boston depicts innovative features of Centronics Data Computer Corp.'s new Model 730 miniprinter. The 50 cps Model 730 features a unique 3-in-1 paper-handling capability and utilizes a heavy-duty free-flight print head. At $995 to end users, the Model 730 is available in seven international configurations.

MICRO INFO

This symbol next to a title in the table of contents indicates that the article is a business-application article.

Manuscripts

Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a self-addressed, stamped envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to the *Microcomputing* editorial offices. "How to Write for Microcomputing" guidelines are available upon request.

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First came the idea. You will do best if you start a business that is in a new field, but one that has great promise of growth. I saw early in 1975 that the Mits Altair computer was starting a revolution, and I felt that a good magazine would be needed to service this field.

In April of that year, I started contacting the editors of computer-club newsletters. I asked Hal Chamberlin if he would be interested in my project. No. Bob Albrecht of People's Computer Company also said no. Then Hal Singer turned me down. It was about then that I found Carl Helmers, who was editing and publishing a small newsletter out of Boston.

My plan was to cover simultaneously the three main elements needed to make a magazine successful: You need a continuing source of good articles if you are going to get and hold readers. You need readers if you are going to get and hold advertisers. You need advertisers if you are going to pay for printing and mailing the magazine to the readers. So I had to organize getting the articles, the readers and the advertisers, all at the same time. It takes experience and a lot of push to do this . . . we did it all in five weeks, possibly a world's record!

After signing Helmers on to edit the articles, I designed the letterhead and envelopes, wrote subscription letters, wrote letters for authors telling them what type of articles we were looking for, and then went through every computer-club newsletter I could find for addresses to send my form letters. The name for the magazine came to me one morning during my shower . . . my best thinking time.

I needed a lot more addresses for prospective subscribers than I could find in the club newsletters, so I contacted manufacturers in the field—Scelbi, Godbout, Martin Research and many others—and convinced them to send me their mailing lists. My newsletters to prospective advertisers were sent out, and things were ready for action.

The job of starting the new magazine would have been much more difficult without the facilities I already had for *73 Magazine*. This gave me the typesetting, art department, editors, circulation people, bookkeeping, a fulfillment service, an advertising-sales department, all able to work hard on the project. I doubt if there was one person on the *73* staff who did not work hard toward starting *Byte*.

In no time it was evident that I had underestimated the market for this new magazine. My original plans for a cautious 2000 print run of a 64-page magazine gradually grew to the eventual 15,000 printing of a 100-pager. The ad response was so good that the very first issue was in the black!

In order to back up the publication, I made a personal visit, carrying issue number one with me, to see the major firms in the business at that time. I visited and talked with Mits, Sphere, Southwest Tech and some smaller firms, taking pictures for my editorials as I went.

Everything went very well, with the type of articles I requested coming in from top-notch authors, with subscriptions growing every month and with advertising also growing every month. The magazine was quickly worth well over a half million dollars and looked as if it would pass a million before the end of its first year. (The sudden and astounding loss of the magazine after its fourth issue was a great surprise and blow to me. I'd put my heart and soul into it; it was a part of me. More will be written about this black era when the court battles subside. The people involved have never again been able to look me in the face.)

So there you have a good example of how you can learn a business by working for someone in the field and then, when you know enough to run your own business, break loose and do it. By working with *CQ* I learned how to edit, how to sell subscriptions, how to sell advertising, how to deal with printers, how to get all of the things done that a magazine needs. Then, when I was free, I had the know-how to start my own magazine . . . and with little money. Very little. It's know-how and determination that count.

Without my experience in publishing I would not have known what type of articles to ask authors to write; I would not have known how to design and have letterhead printed quickly . . . or how to write the letters for articles, for subscriptions, for bulk sales through stores and newsstands and for advertising. I would not have known the people in the field to get all that start-up advertising. We've seen other publishers try to make it in the same field and fail, wasting hundreds of thousands of dollars in the effort, all because they did not have the background I did.

If you are going to think in terms of running your own computer store, just change the words of my experience slightly and you have a parallel situation. If you are going to make an I/O board for the TRS-80 or some other popular system, you need to know what to do and when. You need to understand advertising . . . where to advertise to reach the customers you need. It is sad to see the hundreds of thousands of dollars that are wasted on advertising every month with poorly designed ads and ads run in the wrong medium. This has had a lot to do with the recent sinking of many of the well-known firms in our field. These firms were run by engineers and technicians, not by marketing-savvy people who could see beyond mere circulation numbers when placing advertising.

By the way, there is a new book that every entrepreneur should read. Let me amend that: It's a book that *everyone* should read. The book is *How to Sell Anything to Anybody* by Joe Girard, Warner Books 82-957, $2.25. It's available from the Book Nook as a public service. Joe is listed in the *Guinness Book of World Records* as "The World's Greatest Salesman." He tells you how he does it, and there is something there for everyone who is interested in success. The book is sloppily edited, but the ideas are there, and that's what you're after. From that point of view, it is still worth its weight in gold to you.

Thanks for joining me in this editorial; I hope you enjoyed it. I'll be glad to try to answer questions in the magazine if you send them in. My time for personal correspondence is getting tighter and tighter. With your encouragement, I'll write more about the elements of success.

TRS Articles Wanted

We're looking for articles on just about every aspect of the TRS-80, right from the most fundamental to help newcomers to the system to get aboard, on up to material for the strictly technical hobbyists.

We'd like reviews of all of the accessories that are available, either from Radio Shack or from any other source. We'd like to know how they work, what problems you had hooking them up, any modifications or hints you can pass along to those following you down that trail.

All types of software reviews are needed . . . from Radio Shack programs, Instant Software and

(continued on page 22)

OUTPUT FROM ISI

Sherry Smythe

Visiting Us

Some visitors find us warm, friendly and accommodating. Others are put off by neglect and suspicion. Well, we've had our share of industrial espionage already, so we're a bit wary. If you'll call us ahead of time and explain who you are and set up an appointment, you'll find the red carpet out. If you drop by unannounced, you'll have to take pot luck. Most of the staff are busier than hell, trying to meet a deadline, so the prospect of dropping everything in midsteam for a surprise visitor is not appealing.

Documentation

The better the documentation accompanying a submitted program, the better the chances of a favorable review. Please do not bother to send in programs that are not thoroughly completed and documented. We haven't time to try to figure out from a program listing what a program is supposed to do.

When you submit a program to any publisher you should include a letter telling the publisher what the program is supposed to do, who will want to buy it and what the benefits are to the customers. Then include operating instructions and any useful data on modifications, proposed expansions, etc.

If you have an esoteric scientific program, take a little time to tell the user how to use the program and what it can do. For instance, a program that computes chi squared is probably fantastic, if you know what significance chi squared has. Explain why anyone would want this calculation and how it is used. The makers of scientific calculators probably could have sold several times as many calculators if there had ever been an instruction book that showed how to apply the calculations. Such a book would still sell well.

Se Habla Español?

Although the initial expansion of Instant Software sales into Europe will be with English versions of the programs, it is obvious that eventually all programs should be made available in other languages for optimum sales. This means there is an immediate need for associate editors who are fluent in foreign language(s) to help with translations.

Both the documentation and the programs have to be translated. The documentation can be translated from the English versions and the program translations made from program listings, so no actual equipment is really needed to do this work.

If you are fluent in French, German, Swedish, Danish, Finnish, Norwegian, Spanish, Italian, Korean, Chinese, Japanese, etc., please write to me if you would like to do some program translating.

System Conversions

The original authors of programs will be given the right of first refusal on all translations of programs for systems other than originally written, but we would like to cover as many of the popular systems as possible with our programs. If you are interested in tackling system translations, please let us know what two different systems you have.

The pay will be a minimum of $3 per hour for your spare time, plus a percentage of the royalty. This percentage will depend on the amount of time and effort you put into the program as compared to the original author. Our goal is fairness. A complex program that can be converted to a second system with a couple hours of work will pull a modest royalty percentage. A difficult conversion could go as high as 50 percent of the royalty.

What systems are of most interest for conversions? Well, the more sales a system has, the more royalties there should be. We do need conversions for Heath, Atari, TI, Apple, PET and others.

Foreign Distribution

The proper support of the microcomputer industry seems to indicate a need for program distribution in every country where microcomputers are being sold. Thus we want to hear from individuals and organizations interested in distributing Instant Software overseas.

Distribution is already well along in the U.K., Germany and Italy, but we do need help in most other European countries. South Africa seems to be setting up already . . . I wonder if there are any other countries in Africa where there are microcomputers being sold? We are looking for distribution help in Asia and will be visiting Korea, Taiwan, Hong Kong and Japan in October to meet people interested in this.

Please write and let me know what you can do.

Level I

When we found out via a recent *Kilobaud Microcomputing* reader poll that only 10 percent of the TRS-80 owners were using Level I, we decided to stop worrying about that language. Please submit all programs in Level II. If you also have them in Level I, OK; we'll put that into the package for Level I users, but there will be no more programs published strictly for Level I users.

Incomplete Programs

Please do not send in half-done programs with a note reading, "If you like this I'll finish it." Once you are a famous and very wealthy programmer you may be able to work this way. Some book authors can, once they are well known, but right now only finished programs are acceptable. Once we make you rich as Croseus you can aggravate us and we'll take it. For the time being, please do it our way.

COMPUTER CLINIC

Here is a real brain teaser for all computer clinicians.

A few weeks ago, a most unfortunate and enigmatic thing happened to my Altair 8800A: Smoke started pouring from the power supply board in the area around diodes D9 and D10, which is right where the ac power cord enters the computer. What is puzzling is that, after immediately turning off the power and carefully examining the above-mentioned area, I could find nothing, absolutely *nothing*, burnt, scorched or otherwise blackened. Everything appeared exactly as it usually did, except that the smoke had left behind a strong smell of something like burning plastic, which lingered in the computer for about a week. When I turned the computer on again, it worked as if nothing had ever happened. All the power supply diodes checked out all right.

A few more facts: This happened while one lead of the fan was disconnected; inadvertently, I let this unconnected lead touch the Altair case, which resulted in a big spark.

While the smoke was pouring, the front panel LEDs appeared normal. The computer had been on for about one minute before the smoke started pouring.

As causes, I have so far considered ants, ticks, fleas, spiders and spider webs. However, there was no debris of any kind on the power supply board or under it. Please write as quickly as possible if you have any answers or thoughts on this enigma.

Su-Ming Wu
3486 Saint Susan Place
Los Angeles CA 90066

I have a Data Interface DI 120, Serial No. 1313, line printer on my M6800-based home-brew system,

(continued on page 23)

OHIO SCIENTIFIC'S ✓013

SMALL SYSTEMS JOURNAL

Introduction

In this month's edition of the Small Systems Journal, we shall continue with our detailed description of information-management systems built around OS-DMS and OS-MDMS as designed for 8-inch floppy, Winchester and mini-floppy-based Ohio Scientific computer systems. Beginning with this edition, our discussion will be centered around several types of fixed business systems written around OS-DMS and its capabilities. While it is not practical to list all of the possible applications of OS-DMS systems, several are listed below to give the reader a look at typical applications. It should be borne in mind that variations on these uses are possible.

As mentioned before, information-management systems might be used to maintain house listings for a small real estate company. A file that contained a list of houses for sale could be used for a variety of functions. A report for a potential buyer might list all new houses in a certain city that have three bedrooms, two baths, and a garage and are also priced between $40,000 and $60,000. A prospective renter might want to see a listing of all the apartments for rent that allow pets and children. Sales agents could have complete listings showing every house for sale.

A small manufacturer might use information-management systems to keep track of the raw parts inventory. At the end of every week the status of the inventory could be obtained by running a series of reports. A reorder listing would list any parts that had a quantity in stock less than the reorder level. A complete inventory dump could be given to workers not having access to the computer. Conditional reports might list all items that were purchased from a particular vendor. A finished goods inventory would be handled in much the same way. Other applications are office supplies, cleaning supplies and factory supplies inventories.

Information-management systems could easily maintain a mailing list for a medium size mail-order company. The mailing list might be sorted by state, zip or name. The printing could be formatted to fit all types of removable labels. Most companies would have a use for a computerized mailing list. End of year earning records are sent to employees. Notices might be sent to all vendors supplying raw parts to a company.

In conclusion, the capabilities of information-management are limited only by the imagination of the operator.

OS-DMS SYSTEMS DESCRIPTIONS

The Ohio Scientific OS-DMS information-management system consists of six modules which make up a complete business package. These modules may also be used by the end user as stand alone groups of programs for general business applications. These modules are as follows:

Nucleus—which we have covered in our previous issues.

Payroll/Personnel—permits retrieval of employee information not relative to payroll, e.g., employee's phone number. It also can be used to generate payroll and during the running of payroll it automatically maintains an employee's gross pay to date, regular pay to date, overtime pay to date, commissions to date, other pay to date, F.I.C.A. to date, Federal Income Tax to date, State Income Tax to date, local taxes to date, regular hours and overtime hours to date. Like the other modules, Payroll/Personnel permits easy backup of data, report generation and editing features.

Inventory—provides such things as a complete inventory listing, conditional inventory listing, reorder report, stock checking, order entry, shipping update, receiving update, inventory update and editing features.

Accounts Receivables/Payables—permits file maintenance of receivable and payable files; report generation of such things as accounts receivable journal, age analysis report, an accounts payable listing; and editing features.

General Ledger—allows detailed entry and maintenance of cash receipts and disbursements as well as printing a journal for adult trail purposes. In addition it prints a posting journal, generates management reports and supplies file maintenance utilities.

Query—allows the typical office worker to obtain information from the computer without having to program it. By typing in structured English requests, the user will obtain answers quickly. Query maintains a dictionary of field labels, file descriptions and keywords. It has the ability to obtain or change a specific item of information based on up to ten conditions.

* * * * *

Our emphasis in this issue will be directed toward the accounts receivable operation. Throughout the discussion, accounts payable may be thought of in tandem with accounts receivable because the two systems have a great similarity in their functions: keep track of what is owed. There are definite differences in the systems, but many of the operations in each are perfect parallels. The differences will be denoted where needed.

THE OS-DMS ACCOUNTS RECEIVABLE SYSTEM

The OS-DMS Accounts Receivable System is an information-management package designed to provide the user with specific information showing who has owed him how much money for how long. Through its use, the businessman can control such items as overpayments, COD sales and customer credits. It specifically utilizes an OS-DMS compatible master file along with highly modified OS-DMS utilities for specific tasks. The accessing techniques utilized allow a high degree of expansion and flexibility in the system without reprogramming.

The functions built into the system include an updating program that handles all the normal data entry, report writers that produce an A/R journal, an age analysis, a detailed age analysis, a customer list, customer statements and master file dumps. Automated creation of the master file is part of the system, as is a backup procedure that makes it easy for the operator to protect the data. An editing program is part of the system to enable quick changes of any item in the A/R master file.

It should be noted that since this system is built on the base OS-DMS data management system, programs in the nucleus of the system may be used to expand on the capabilities listed above. This feature gives the user a great amount of flexibility in the final design of his system.

* * * * *

In the normal office environment, the flow of funds—both incoming and outgoing—is a normal occurrence. Part of this flow is in cash, which generally signifies the completion of a transaction, but part of it is also done through credit: delivery of goods or services for the promise of future payment.

Accounts receivable is that portion of financial record-keeping concerned with how much money a given company is owed, who owes it the money, and when the debts must be paid.

The OS-DMS accounts receivable system is designed to fit into this office environment in the following manner.

Invoices are sent to purchasers on a regular basis. As they are sent, the person performing the accounts receivable clerical function (the clerk) enters the invoice numbers, dates, general ledger account numbers and amounts of the new invoices on the computer (posts the data) through the console keyboard. In order to enter these invoices, some new customers must ordinarily be put on the computer to accompany the transaction data. This entails entering their names, addresses and other static information into the computer through the same console keyboard. Along with all this billing, of course, payments of previously sent invoices are being received. When these payments come in, they are posted into the proper accounts and erase the applicable records of funds due. The cycle is continuous and, in most situations, smooth in its operation, but peaks will appear in seasonal industries and the like.

All this information being entered into the computer is retained in the equipment for only a short period of time. For future access, the data is stored in individual customer records in an accounts receivable master file on disk (floppy or fixed) held in the disk drive unit(s) of the computer. The data may then be recalled at some future point in time to indicate its presence or be further processed. The process of entering this information also leaves a record for the office personnel to reference. A printed Input journal is produced as an audit trail so that both the clerk and the person overseeing the operation of the accounts receivable (the manager) can readily tell what processing has been performed and when it occurred. A typical input journal might look like the following:

ACCOUNTS RECEIVABLE INPUT JOURNAL 01/25/79 8:42

ACTION	CUSTOMER	INV NUM	INV DATE	ACCT #	AMOUNT
NEW CUSTOMER	JONES & JONES CONS. CO	30445	01/12/79	4010	3998.50
NEW CUSTOMER	EDWIN A WILLIAMS & ASSO	29815	01/16/79	4010	407.80
NEW INVOICE	ASSO PRODUCERS INC	30573	01/16/79	4010	300.45
NEW INVOICE	ASSO PRODUCERS INC	39887	01/19/79	4010	3559.68
RECEIVE PYMT	CAROLINA SHIPPERS COOP INC (CHECK # 33579)				2000.00
2000.00 APPLIED TO # 30046-A DATED 01/15/79					
RECEIVE PYMT	ASSO PRODUCERS INC (CHECK # 66045)				9500.00
359.00 APPLIED TO # 2203 DATED 01/15/79					
7888.95 APPLIED TO # 2207 DATED 01/17/79					
350.75 APPLIED TO # 2210 DATED 01/20/79					
300.45 APPLIED TO # 30573 DATED 01/16/79					
600.85 APPLIED TO # 39887 DATED 01/19/79					

// END RUN //

Once the invoices have been entered into the computer, they are available for further processing. Payments may be received on them, they may be modified or they may be deleted. They may also be listed in various formats, used as subject matter for statistical reports, or processed further. The following are some of the products available with this system:

The Accounts Receivable Journal

This is a report showing the specifics of all invoices for each customer requested. It may be printed on paper or on the console terminal depending on the needs of the user. These needs may be for a billing roster, a picture of the entire receivables situation, or management information about a particular customer. Due to its detailed contents, full file printouts of this can be lengthy and should not be printed too frequently.

ACCOUNTS RECEIVABLE JOURNAL

DATE 1/31/79 PAGE 1

CUSTOMER NAME	INV NUMBER	INV DATE	ACCT #	AMOUNT
ASSO PRODUCERS INC	39887	01/19/79	4010	2958.83
ASSO PRODUCERS INC	26774	12/05/78	4010	256.57
ASSO PRODUCERS INC	22346	10/12/78	4010	322.46
		CUSTOMER TOTAL:		3537.86
CAROLINA SHIPPERS	30046-A	01/15/79	4010	451.50
		CUSTOMER TOTAL:		451.50
JONES & JONES CONS.	30445	01/12/79	4010	3998.50
JONES & JONES CONS.	26559	11/20/78	4010	3004.50
		CUSTOMER TOTAL:		7003.00
E. A. WILLIAMS	29815	01/16/79	4010	407.80
		CUSTOMER TOTAL:		407.80
		GRAND TOTAL:		11400.16

The Master File Dump

This report prints accounts receivable master file records for historical storage or management information needs. It lists the entire contents of each accounts receivable record requested in a predetermined format. Two routines exist to print this listing—one to print the entire file and one to print selected master records chosen by varied conditions. The full file printout of this can be very lengthy.

```
OS-DMS ACCOUNTS RECEIVABLE MASTER FILE LISTING   1/31/79
..............................................................................
CMPNY # 1010                              (RECORD #1)
CONTACT: MR H. JOHNSON
COMPANY: ASSO PRODUCERS INC
STREET: PO BOX 3847
CITY: ATLANTA            STATE: GA  ZIP: 30306  LINK BACK: 0  LINK FORWARD 5
INV NUM  INV DATE ACCT#  BALANCE  INV NUM  INV DATE ACCT#  BALANCE  INV NUM  INV DATE ACCT#  BALANCE
39887    01/09/79 4010   2958 83  26774    12/05/78 4010   256 57   22346    10/12/78 4010   322 46
0        0        0         0.00  0        0        0         0 00
COMMENTS: 0
..............................................................................
CMPNY # 2350                              (RECORD #2)
CONTACT: N/A
COMPANY: CAROLINA SHIPPERS COOP INC
STREET: ROUTE 29
CITY: GASTONIA           STATE: NC  ZIP: 27603  LINK BACK 0  LINK FORWARD. 0
INV NUM  INV DATE ACCT#  BALANCE  INV NUM  INV DATE ACCT#  BALANCE  INV
                                                                    NUM      INV DATE ACCT#  BALANCE
30046-A  01/15/79 4010    451.50  0        0        0         0 00  0        0        0         0.00
0        0        0         0.00  0        0        0         0 00
COMMENTS: 0
..............................................................................
CMPNY # 3050                              (RECORD #3)
CONTACT: MS GLADYS JONES
COMPANY: JONES & JONES CONSTRUCTION CO
STREET: 1193 BROADWAY
CITY: CHICAGO            STATE: IL  ZIP: 60602  LINK BACK: 0  LINK FORWARD: 0
INV NUM  INV DATE ACCT#  BALANCE  INV NUM  INV DATE ACCT#  BALANCE  INV
                                                                    NUM      INV DATE ACCT#  BALANCE
30445    01/12/79 4010   3998 50  26559    11/20/78 4010   3004 50  0        0        0         0 00
0        0        0         0.00  0        0        0         0 00
COMMENTS: 0
..............................................................................
CMPNY #4003                               (RECORD #4)
CONTACT: N/A
COMPANY: EDWIN A WILLIAMS & ASSOCIATES
STREET: SUITE 10
CITY: WASHINGTON         STATE: DC  ZIP: 20013  LINK BACK: 0  LINK FORWARD: 0
INV NUM  INV DATE ACCT#  BALANCE  INV NUM  INV DATE ACCT#  BALANCE  INV
                                                                    NUM      INV DATE ACCT#  BALANCE
29815    01/16/79 4010    407.80  0        0        0         0.00  0        0        0         0.00
0        0        0         0.00  0        0        0         0 00
COMMENTS: 0
..............................................................................
CMPNY # 1010                              (RECORD #5)
CONTACT: MR H. JOHNSON
COMPANY: ASSOCIATED PRODUCERS INC
STREET: PO BOX 3847
CITY: ATLANTA            STATE: GA  ZIP: 30306  LINK BACK: 1  LINK FORWARD: 0
INV NUM  INV DATE ACCT#  BALANCE  INV NUM  INV DATE ACCT#  BALANCE  INV
                                                                    NUM      INV DATE ACCT#  BALANCE
0,       0        0         0.00  0        0        0         0.00  0        0        0         0.00
0        0        0         0.00  0        0        0         0.00
COMMENTS: 0
..............................................................................
```


Reader Service—see page 195

The Editing Journal

The program that is used for general-purpose updates in this system prints a journal to document all modifications made to the A/R master file. Not only does this provide protection against accidentally updating the wrong item and not knowing what was destroyed, but it also gives the user a written record of all miscellaneous changes made to the file.

OS-DMS EDITING JOURNAL. FILE NAME: ARMSTO.
DATE: 1/31/79. TIME: 3:48

RECORD #: 3 FIELD #: 2 FIELD LABEL: CONTACT
OLD: MS GLADYS JONES
NEW: MR HAROLD SMITHERTON

RECORD #: 1 FIELD #: 4 FIELD LABEL: STREET
OLD: PO BOX 3847
NEW: 18295 ALLENDALE AVE SW

The Age Analysis Printouts

These runs are useful for both management information and historical purposes. This system provides two types of aged reports—one showing each customer's situation at a glance and the other showing the aging status of each invoice in detail as well as the total customer analysis. These reports give management personnel a useful tool with which they may make knowledgeable decisions, since with these reports it is possible to see cash flows, forecast income and interpret figures intelligently.

Our first example is that of a general-purpose age analysis, showing for each customer both the balances outstanding over the different time periods and the percentage of the total balance which are in the given age categories.

ACCOUNTS RECEIVABLE AGE ANALYSIS

DATE 01/31/79 PAGE 1

CUSTOMER NAME	TOTAL BALANCE	0-30 BALANCE	31-60 BALANCE	61-90 BALANCE	OVER-90 BALANCE
ASSOCIATED PRODUCERS INC	3537.86	2958.83	256.57	0.00	322.46
PERCENTAGES OF CUSTOMER TOTAL:	100.00	83.63	7.25	0.00	9.11
CAROLINA SHIPPERS COOP INC	451.50	451.50	0.00	0.00	0.00
PERCENTAGES OF CUSTOMER TOTAL:	100.00	100.00	0.00	0.00	0.00
JONES & JONES CONSTRUCTION CO	7003.00	3998.50	0.00	3004.50	0.00
PERCENTAGES OF CUSTOMER TOTAL:	100.00	57.09	0.00	42.90	0.00
EDWIN A WILLIAMS & ASSOCIATES	407.80	407.80	0.00	0.00	0.00
PERCENTAGES OF CUSTOMER TOTAL:	100.00	100.00	0.00	0.00	0.00
GRAND TOTALS:	11400.16	7816.63	256.57	3004.50	322.46
PERCENTAGES OF GRAND TOTAL:	100.00	68.56	2.25	26.35	2.82

The detailed age analysis shows the age status of each invoice outstanding as well as the total amount for each customer and the run. In addition, the percentages of the grand total which are found in each age category are indicated at the end of the report.

ACCOUNTS RECEIVABLE DETAILED AGE ANALYSIS

DATE 01/31/79 PAGE 1

CUSTOMER NAME/INVOICE #	TOTAL BALANCE	0-30 BALANCE	31-60 BALANCE	61-90 BALANCE	OVER-90 BALANCE
ASSOCIATED PRODUCERS INC					
39887	2958.83	2958.83			
26774	256.57		256.57		
22346	322.46				322.46
CUSTOMER TOTAL:	3537.86	2958.83	256.57	0.00	322.46
CAROLINA SHIPPERS COOP INC					
30046-A	451.50	451.50			
CUSTOMER TOTAL:	451.50	451.50	0.00	0.00	0.00
JONES & JONES CONSTRUCTION CO					
30445	3998.50	3998.50			
26559	3004.50			3004.50	
CUSTOMER TOTAL:	7003.00	3998.50	0.00	3004.50	0.00
EDWIN A WILLIAMS & ASSOCIATES					
29815	407.80	407.80			
CUSTOMER TOTAL:	407.80	407.80	0.00	0.00	0.00
GRAND TOTALS:	11400.16	7816.63	256.57	3004.50	322.46
PERCENTAGES OF GRAND TOTAL:	100.00	68.56	2.25	26.35	2.82

The Accounts Receivable Statements

These are sent to the customers on a periodic basis to inform them of their current financial positions with us. The accounts receivable journal makes a fine statement journal for this printout, as its contents are the same as those printed on the statement.

OHIO SCIENTIFIC, INC
1333 S. CHILLICOTHE ROAD, AURORA, OHIO 44202
(216) 562-3101
STATEMENT OF ACCOUNT
AS OF 1/31/79

TO:
ASSOCIATED PRODUCERS INC
PO BOX 3847
ATLANTA, GA 30306
ATTN: MR H. JOHNSON

INV NUMBER	INV DATE	ACCT #	AMOUNT
39887	01/19/79	4010	2958.83
26774	12/05/78	4010	256.57
22346	10/12/78	4010	322.46
TOTAL BALANCE DUE:			3537.86

The Customer Listing

The staff that handles the paperwork always needs to have a ready reference to what items are currently on any given file. For this system, a customer list is the document that shows which customers are presently active and how they may be found most easily.

ACCOUNTS RECEIVABLE CUSTOMER LIST
DATE 1/31/79 PAGE 1

CUSTOMER NAME	CUSTOMER NUMBER	RECORD NUMBER
ASSOCIATED PRODUCERS INC	1010	1
CAROLINA SHIPPERS COOP INC	2350	2
JONES & JONES CONSTRUCTION CO	3050	3
EDWIN A WILLIAMS & ASSOCIATES	4003	4

OS-DMS ACCOUNTS RECEIVABLE SYSTEM OVERVIEW

Now that we have presented our various printed products, we shall briefly describe how all the routines that produce these reports are tied together to make a system rather than just a group of programs. The entire series of operations that goes into coordinating the daily routines of the user must be taken into account, from the building of the file, the data entry and reporting routines right up to the security aspects being taken care of in the backup routines.

The coordination required is centered in a routine generally referred to as the primary menu program. This is the hub of the operations in the system, since it is the first program active in the system and is seen between all the routines performed by the operator. It merely presents a list of available operations the user may select from, and when the selection is made, transfers control to the appropriate routine to perform the task desired. The following is the menu for this system:

OS-DMS ACCOUNTS RECEIVABLES

1. A/R MASTER UPDATE
2. PRINT A/R JOURNAL
3. COMPLETE A/R MASTER DUMP
4. CONDITIONAL A/R MASTER DUMP
5. A/R MASTER EDIT
6. PRINT A/R AGE ANALYSIS
7. PRINT DETAILED A/R AGE ANALYSIS
8. CREATE NEW A/R MASTER FILE
9. PRINT CUSTOMER LIST
10. PRINT CUSTOMER STATEMENTS
11. BACKUP A/R MASTER FILE

12. EXIT A/R SYSTEM

All normal data entry is made through the selection of item number one. Corrections and adjustments may be made through the selection of item number five. The protection of the data is handled through item number eleven. Item twelve is available so that programmers may exit from the production environment and modify the system when needed.

Differences in the accounts receivables and payables were mentioned at the beginning of this article. As the reader can see, most of the functions performed by this system may be used in either system. The primary differences which may be found lie in the customer statement area. The customer statement indicates the amount of money owed by the customer. Its counterpart, a vendor statement, is printed to indicate to a vendor exactly what items are being paid for with a given remittance being sent to that vendor. The printed format is very similar. Only the logic used to find the amounts is different.

In the next issue of the Small Systems Journal, we shall review another of the fixed business systems implemented under OS-DMS.

Reader Service—see page 195

BOOKS

8080/8085 Software Design
Titus, Rony, Larsen, Titus
Howard W. Sams & Co., Inc., Indianapolis IN
Softcover, 334 pp., $9.50

When you run across something that appeals to you, it is human nature to want to "pass the word." Six months ago I bought a copy of *8080/8085 Software Design*, hoping that it wasn't just another book explaining 8080/8085 instructions. I wasn't disappointed. Not only have the authors avoided simply listing the instructions with a brief explanation, they haven't "listed" them at all.

Rather, chapter 1 starts the reader at square one. By assuming that the reader has no familiarity with the two processors, a commonality is established. The registers, flags, status lines and general operation of the device are explained. Also, conventions used throughout the book are established and explained. One commendable convention is the use of both octal and hex formats for op code presentation.

Chapter 2 introduces the basic instructions (data-movement, input/output (I/O), logical and mathematical, and branching and decision-making). Each instruction group is introduced in a logical manner such that all instructions within that group are associated in the reader's mind. For example, all register-to-register movement instructions start with an octal 1 in the op code, and are formatted as 1DS, where D is the code for the destination register and S is the code for the source register. The destination is always specified first. The effect on the various registers and flags with a group of instructions is explained as appropriate.

Also, the reader is shown how to use some instructions to replace less powerful instructions. For example, LXI H replaces MVI H and MVI L . . . obvious to an experienced programmer, but not to a novice. This replacement technique is not developed in the context of "look at this neat trick," but rather in the context of helping the reader to logically group the instructions in his/her mind to design programs with the intention of optimizing the number of instructions. In that vein, the authors have included 39 executable programs in chapter 2 as illustrations.

Chapter 3 begins the "software design" aspect of the book in earnest by posing some hypothetical programming goals, then assisting the reader in thinking through to the solution. Flowcharts and diagrams are used to good advantage. This and subsequent chapters are laced with good programs that can be keyed into the reader's machine and run, or incorporated into a system monitor (general-purpose TTY I/O routines, binary-to-ASCII-based hex conversion subroutines, etc.). Chapter 3 concludes discussion of, and example programs using, the basic instructions with a summary of the instruction groups.

Chapter 4 introduces the advanced instructions, then poses examples where one or two instructions can replace many additional instructions and perform the same function. Additionally, the authors introduce a very powerful teaching device in this chapter. The reader is asked to explain, step-by-step, the effect a program has on a register, register pair, flag, etc. The authors then explain the effect, which has the benefit of giving the reader confidence in his/her comprehension of the material and a good insight into how the machine really works.

Now that all 244 of the 8080/8085 instructions have been explained, the authors press on to the "meat" of programming in chapter 5 with 28 programs that illustrate multiprecision integer addition, subtraction, multiplication and division. BCD arithmetic is discussed briefly. At the end of this and most other chapters, references are provided, should the reader wish to investigate the subject matter more in depth.

Number-base conversions are discussed and illustrated in chapter 6; most of the 26 programs are suitable for use in readers' programs. Octal, hex and ASCII coding of both systems are explained very well. One such program is "A Binary-to-ASCII-Based, Octal Conversion Subroutine That Uses a Loop" (a similar program is given for hex). The authors go on to compare this program with a loop to one without a loop—again reinforcing the "software design" aspect of the book.

Chapter 7 wraps up the book with discussion of I/O routines, both accumulator and memory-mapped. One point the authors make in this chapter is that hardware-related software without a schematic or detailed hardware explanation is useless. So where appropriate, schematics have been included. Programs and schematics cover, among other things, a simple keyboard interface and LED displays, single digit to multiplexed 10 digit.

This book is by far the best 8080/8085 assembly-language software book I have read. The style in which the book is written is very readable and easy to follow. As a testimonial to the efficacy of the book, I wrote a 150-line monitor for my homebrew 8080 system with only three mistakes—my first attempt at assembly-language programming. That's why it has taken me six months to "spread the word" about this book—I'm enjoying using it too much to write about it! The only drawback the book has is something it hasn't—an index of instructions. However, the book is organized in a very logical manner, so it is a simple matter to refer to the ample subject index under the type of instruction being sought. My recommendation to all but the most experienced 8080/8085 assembly-language programmer: Buy the book!

James C. Hassall
Blacksburg VA

Digital Concepts Using Standard Integrated Circuits
Richard S. Sandige
McGraw-Hill
New York NY, 1978
$20.95, Hardcover

While written to be used as a text for a first course in digital IC devices, *Digital Concepts* is adequately written—from the conversational style to the tutorial-like organization and topical presentation—to be used as a self-paced study guide for anyone with even a rudimentary knowledge of ac and dc circuits. The author makes an appropriate recommendation that the reader obtain *The TTL Data Book For Design Engineers* (2nd ed.) from Texas Instruments if the examples are going to be implemented on a breadboard.

Armed with the TI reference, the reader will move from little or quite antiquated knowledge of digital electronics to a current understanding of—and with some low-cost breadboarding, the ability to implement—simple and some not-so-simple multiple-IC circuits.

Sandige has gone far enough in the direction of theory to introduce state diagrams and Karnaugh-map reduction, but has also devoted enough effort to applications to label most diagrams with specific 74xx or equivalent IC nomenclature, thus emphasizing the laboratory/breadboard orientation of the book.

The book includes a preface, list of abbreviations, bibliography, answers to (selected) exercises and an almost adequate index. There are also appendices ranging from "preferred" resistance values to the powers of two (2^n, $0 \leq n \leq 20$).

The first chapter is an overview of the rest of the book. The remaining chapters, 2-13, go through the techniques of design and use of ICs through the 555 timer and into a brief exposure to medium- and large-scale ICs such as registers, memories and microprocessors. Some medium-scale ICs are covered in chapters 2-12 (e.g., decoders and data selectors). This seemingly limited topic coverage is one of the strong points of the book: It permits the author to devote more effort to writing in a tutorial style—a stated goal of the book. Specific chapter topics are:

Chapter 2. "Data-Book Information and Breadboarding." Nuts-and-bolts data-book information is presented to illustrate the range of digital ICs available. The reader is introduced to breadboarding, digital wiring diagrams, data books, IC identification schemes and package styles, and is encouraged to start wiring small digital systems immediately.

Chapter 3. "Commonly Used Number Systems." For the reader with little or limited knowledge of number systems, this chapter will provide a good exposition of the basics of number systems and cover the binary, octal and hexadecimal number systems in particular.

Chapter 4. "Fundamental Digital Concepts." This chapter is a

(continued on page 14)

ESFOA Newsletter

Secretary, Fred Waters

This is the second newsletter of the EXATRON STRINGY FLOPPY OWNERS ASSOCIATION. We have some exciting things to tell you about this remarkable mass storage subsystem, and about where we are now a few months after the introduction of the TRS-80 Stringy Floppy at the Fourth West Coast Computer Faire.

For new subscribers who didn't see the first newsletter in the August issue, the Stringy Floppy is pictured at the right. Add a flat cable for a connection into the back of the TRS-80, and a small sealed-unit power supply for the AC outlet, and you have the TRS-80 model ESF. It will load a 4K-byte program into memory in 6 seconds, or a 16K-byte program in 24 seconds. You can save programs on tape at the same rate. Aside from the speed and convenience, the most remarkable feature of the Stringy Floppy is its extreme reliability. The subsystem is operated entirely by software commands, with no knobs, switches or other physical controls; and because all parts of the system design are to digital standards, it is very very difficult to make it misread or misload. Gordon French, one of the "grand old men" of hobby computing, and a co-founder of the very first computer club–the Homebrew Computer Club–was heard to remark at a recent meeting of a local TRS-80 Users Group: "I've watched the Stringy Floppy demonstrated many times since it was first introduced at the Third Computer Faire back in 1978, and I've never seen it fail to work properly!"

When introduced, the TRS-80 model had only two commands: "@SAVE" and "@LOAD". It was fairly obvious that two other capabilities were needed: multiple files on one wafer, and data files. These were already in preparation at the time. As of this writing they are close to release, but because of the editorial time-lag I can make no positive statements. So. . .use the toll-free number below and give us a call. By the time you read this much more information will be available.

STRINGY FLOPPY FOR THE SS-50

The Exatron Stringy Floppy for 6800 microcomputer systems, most immediately the SWTP, is now up and running. The software is in EPROM, and contains the utilities for I/O and printer as well as the formatting and operating routines. The SS-50 has a dual-drive capability, and will support an ACIA on Ports 1 and 2 of the SS-50 bus. Call our toll-free number below for price and delivery information.

EXATRON POLICY

As we told you in the last newsletter, ESFOA is a voluntary informal alliance of enthusiasts; it is independent of the Exatron Corporation. EXATRON is in the business of the design, manufacture, and sale of high quality systems and subsystems for personal and small business microcomputers, and not in the development of commercial software. EXATRON does however support the Exatron Stringy Floppy Owners Association (ESFOA), and will support members who undertake software development projects of general interest to other members.

The Company encourages members of ESFOA to attend workshops and participate in software development projects, and will assist members in the publication and distribution of software of general interest. Much more about this later.

PRODUCT IMPROVEMENT

The firmware operating the Stringy Floppy is in a 2716 EPROM on the PC board. As software and operating capabilities are added to the ESF, they will be made available to ESF owners by exchange of 2716s. At the appropriate time all software will be programmed onto masked ROMs, to be made available at modest cost, and the 2716 will then be yours to add to an EPROM board.

FLASH!! – As this article is being put in final form, we have just gotten word that the software for the added capabilities has been written, is being debugged, and is close to release under the moneyback guarantee and full warranty. As you are reading this, the Stringy Floppy has in EPROM the commands to dump complete memory on tape, or to SAVE numbered files from 1 to 9, or selectively to LOAD a numbered file into memory. ALSO, in RAM, to accompany Level III BASIC, the following: SAVE a BASIC program with Autostart; SAVE a machine language program with or without Autostart: PRINT data on tape; and INPUT data from tape. For complete last-minute information, and to place an order, call us on the toll-free line.

SPECIAL OFFER

As noted at the end of this page, the price of the Stringy Floppy for TRS-80 is $249.50. Included in this is a credit for $50.00, which you can use in several different ways. These are:

1. G2 Level III BASIC, by Microsoft, distributed by GRT Corporation, for a credit of $49.50
2. A year's subscription to Microcomputing, for a credit of $18.00
3. Instant Software, by Instant Software Inc., at list price
4. Additional wafers for the ESF, at list price

Not only can you use the toll-free line to keep up to date on product improvement, you can also use it to order your Stringy Floppy. Be the first in your users group to add this marvelous mass storage capability to your TRS-80. Call 800-538-8559 and place your order now!

PRODUCT AVAILABILITY

Exatron Stringy Floppys and related supplies and equipment are sold only by the manufacturer. This is to keep the cost down–a reasonable goal these days. There are other advantages to the buyer. Since it's a sealed unit, guaranteed to work in your TRS-80, and since there is no learning process, you don't need services normally furnished by your dealer. Most important, product support–delivery, warranty backup, and information–is fast, accurate, and completely up to date. Our toll-free number brings us as close to you as your telephone.

HOW TO ORDER

The Exatron Stringy Floppy for the TRS-80 is assembled and tested, and is covered by a 30-day moneyback guarantee and a one-year full warranty. Within seconds of turning on your TRS-80, your ESF is up and running. The ESF is $249.50, which includes the $50.00 credit described above in the Special Offer. Tell us how you want to use your credit. List price for a box of 10 wafers, 5-ft, 10-ft, or 20-ft, is $20.00. The BUS-EX, a multiple connector for two or more peripherals, is $15.00. All prices include shipping and handling; CA residents add tax. To order fast, call our toll-free number and give us your Master-Charge or Visa number. If you have any questions about the product, call us toll-free.

If you have any questions about these products, about Exatron, or about ESFOA, call the HOT LINE. Address letters to ESFOA, 3557 Ryder St., Santa Clara, CA 95051.

Stringy Floppy is a trademark of Exatron Corporation.

HOT LINE * 800-538-8559
WITHIN CA 408-737-7111

**Effective July 13th*

BOOKS

(from page 12)

more or less classical introduction to Boolean representation, the ANSI and IEC symbols and digital logic gates in general.

Chapter 5. "The Level Method of Analysis." An introduction to the author's preferred method of logic analysis. The level method allows actual voltage levels to be represented along with the logic equations and permits an easier circuit understanding and transition to the breadboard than the more classical methods of chapter 4.

Chapter 6. "Boolean Functions and Reduction Techniques." Karnaugh-map reduction techniques are presented to enable the reader to obtain a minimum hardware configuration to accomplish a given logic function.

Chapter 7. "Circuit Types and Interfacing." An especially well-done introduction to the often burdensome task of making different families of logic "talk" to each other. Starting with relay logic, the author takes us on a tour of DTL, RTL, TTL, ECL, HINL, CMOS and I^2L logic devices.

Chapter 8. "Totem-Pole, Open-Collector and Three-State Outputs." This is a welcome chapter. It covers that often gray area of output type. As has been done several times throughout the book, the reasons *why* each type of output exists are included with the description of the output.

Chapter 9. "Code Converters, 7-Segment Displays, MSI Data Selectors and MSI Decoders." Several popular types of displays are presented. Means of code conversion are discussed within specific applications, making them especially easy to follow and remember.

Chapter 10. "EXCLUSIVE-OR Gates and Binary Addition Circuits." MSI packages for XOR and full adders are presented in the context of useful applications. These are then used to design a simple arithmetic logic unit (ALU) capable of adding and subtracting.

Chapter 11. "Latches and Flip-Flops." RS and gated latches, master-slave and edge-triggered flip-flops and a variety of frequently encountered flip-flop types are presented. Flip-flop types include RS (called by the author S-R, but who's perfect?), D, JK and T. Making one type of flip-flop from another is covered in enough detail to relieve most readers of having to suspend a 2 AM project just because the ol' IC collection is out of a particular flavor of flip-flop.

Chapter 12. "Basic Sequential Logic Analysis and Design Techniques, Counters and Controllers." Small- and medium-scale digital devices are used to implement a range of operations.

Chapter 13. "Additional Integrated Circuits." The ubiquitous 555 timer IC is covered in some detail, and MSI registers (the 74194, in particular), memories (8111-2 RAM and 1702A EPROM) and LSI microprocessors (8080 and 6800) are briefly sketched.

Chapters 2-13 have review exercises, several of which have their answers at the end of the book.

The style of presentation is almost Socratic. Following an orientation to a new topic, the topic is explored via examples that are of a question-then-answer nature. Indentation enables the reader to distinguish examples from regular text. As does any book, *Digital Concepts* has some shortcomings: The index is too brief for an introductory text (e.g., try to find switch debouncing—it *is* there, if you want to search the index linearly, under "contact-bounce-eliminator"), and while chapters do start with a statement of their goals, they have no summaries. Similarly, there is no index by IC number. Overall, though, the shortcomings are small compared to the book's strong points. The book will make a welcome addition to both the beginner's and the experienced reader's library.

Dr. Douglas H. Haden
Mesilla Park NM

Starting and Managing Your Own Engineering Practice
John A. Kuecken
Van Nostrand Reinhold Company
New York NY, 1979
$12.95, Hardcover

Don't let the title of this book make you think it is not for you. Software engineering is extensively discussed, and much of the advice given applies to anyone in a self-employed status: engineer, programmer, one-man service bureau or otherwise.

In the June 1979 issue of *Microcomputing*, Thomas Laich didn't speak too highly of *The Datasearch Guide to Low Capital, Startup Computer Businesses.* Perhaps this is the book he should have read, although even this small volume will not tell you *what* to do in your computer business. This book will give you guidance and advice that will help you decide if the time is right, enough funds are available and if you have the makings of a successful self-employed entrepreneur.

"Successful" can mean different things to different people. I think I am qualified to judge this work because I have been self-employed for just under two years, and the pangs of startup are still fresh in my mind. The author, John Kuecken, has been successful for many years, so can speak with real authority.

This he does well, in an amusing style. His tone is sufficiently pessimistic so that you are not misled into an unsupported belief that you will become a millionaire overnight. In fact, his pessimism extends to the prediction that it will take you three years to break even, and six years to establish an income equal to what you would have if you had stayed employed in a comfortable, stifling job. In our dynamic, expanding field, these predictions are a little too severe, but do serve to warn you of the effects of lean years to come.

The topics covered are detailed adequately, but some items of information a beginning entrepreneur will need are totally ignored. In mentioning these, Kuecken states, "There are a number of textbooks on the market. . . ." but fails to include a bibliography to help you find them. This is the book's weakest point. It is devoid of references to any other publications.

But the friendly, fatherly advice included makes the volume more than worth its modest price . . . such items of wisdom as, "The consultant is of value only so long as he is ahead of the state of the art," and "A mediocre solution which departs little from what the client is doing now is often better received." Taken out of context, these statements may seem to be in conflict, but they exemplify the type of priceless guidance that is included in this work.

The author repeatedly leads you into the kind of real-life situations you will encounter in dealing with a variety of customers, and shows you the most effective approach to the solution of their problems. Application of the most exotic or advanced technology is not always the answer.

This advisory tone is followed throughout the book. Beginning with an attempt to define "professional" (impossible!), the author guides you in establishing an office (initially in your home, he recommends), finding clients, funding your operation, selecting equipment and personnel and making written and verbal presentations.

Several of his topics are covered superbly; others are barely mentioned. In the latter category are proposal and inquiry writing. However, these subjects are proper for an entire volume each, so you can't expect this book to go into too much detail. And it doesn't—which makes the lack of references a serious omission.

On the bright side, the guidance that is in the book is all pertinent and valuable, and I certainly intend to apply some of it to my own business. First, I am going to follow Kuecken's advice and specifications and prepare a brochure explaining the facilities and accomplishments of my business—something that had not yet occurred to me to do. I can't follow his advice on the selection of a secretary because I'd rather have the blonde with blue eyes than the one who knows what LSI means.

John Kuecken states that "a programmable computer is nearly a must," which hits us right where we live. But, of course, a computer is not everything you need to establish your own business. Studying his book will help you decide if you have what else it takes. When you get to the last chapter, the author asks, "Do you really want to do this?" He and I both suggest that if it is at all possible, do it!

Ken Barbier
Borrego Springs CA

Contest!

Each month, our readers vote one article as the best of the issue. Winner receives $100.

Voted best article for June 1979 was "Monitor" (page 26) by Rod Hallen. Congratulations, Rod.

We also draw from among the votes to choose a winner of a Book Nook book . . . the winner is Alex R. Shevekov of Sunnyvale CA.

Both sides now

North Star Announces —
Double Density x 2 Sides = Quad Capacity!

The North Star Horizon now delivers quad capacity by using two-sided recording on our new mini drives! That's 360,000 bytes per diskette! A four drive North Star system accesses over 1.4 megabytes of information on-line! Think of the application flexibility that so much information storage can give you!

North Star has quadrupled the disk capacity of the Horizon computer but prices have increased a modest 15 percent. On a dollar per byte basis, that's a bargain that is hard to beat!

The proven North Star disk controller was originally designed to accommodate the two-sided drives. North Star DOS and BASIC are upgraded to handle the new capacity, yet still run existing programs with little or no change. Of course, single sided diskettes are compatible with the new disk system.

North Star Horizon Computer Prices (with 32K RAM), assembled, burned-in and tested:

Horizon-1-32K-Q	$2349
Horizon-2-32K-Q	$2999
Horizon-1-32K-D	$2099
Horizon-2-32K-D	$2549

Get both sides now! Quad capacity is available from your North Star dealer.

NorthStar

North Star Computers
2547 Ninth Street
Berkeley, CA 94710
(415) 549-0858 TWX/Telex 910-366-7001

NEW PRODUCTS

Edited by Dennis Brisson

Model II microcomputer with line printer, external disk system and system desk.

Single- and Double-Density Drives

The LFD-800 and LFD-1000 have been added to the line of LFD mini-disk systems for 6800/6809 computers by Percom Data Company, 211 N. Kirby, Garland TX 75042. The LFD-800 stores 200K bytes in single-density format on 77 tracks and is available in one-, two- and three-drive configurations. The LFD 1000 is a dual-drive system that stores 400K bytes per disk—800K bytes per system—in double-density format on 77-track disks.

A system is supplied complete with an SS-50 bus controller/interface PC card, an operating system on EPROM, an operator's manual and an interconnecting cable. The LFD-400/800 controller/interface accommodates up to three drives, and the LFD-1000 controller/interface accommodates either one or two LFD-1000 dual-drive systems.

In addition to Minidos-Plusx, the EPROM operating system supplied with each drive system, Percom also offers two advanced operating systems, Index and CP/68, for use with LFD drive systems. The operator's manual describes each system component and includes operation, service and maintenance procedures for the drive.

The two-drive LFD-1000 costs $2495, while the four-drive LFD-1000 costs $4950. Prices for the LFD-800 are: one-drive, $895.95; two-drive, $1549.95; and three-drive, $2195.95. Texas residents, add 5 percent sales tax. Reader Service number P59.

Quadruple Storage

New System 8813s are now optionally available with four times the storage capacity of the standard unit. Instead of 90,000 characters of storage per diskette, PolyMorphic customers now may choose to quadruple storage to 360,000 characters per diskette. The fourfold increase in diskette capacity is made possible by double-sided disk drives and double-density recording. While storage increases fourfold, retrieval time decreases by a factor of four due to the Z-80 disk controller and track buffering.

These new 5 1/4 inch disk drives are available as an option with the System 8813; a three-drive 8813 may now support more than one megabyte of storage.

PolyMorphic Systems, 460 Ward Drive, Santa Barbara CA 93111. Reader Service number P4.

TRS-80 Model II

Radio Shack's new TRS-80 Model II Microcomputer System is designed to meet the needs of many users for more data storage, greater versatility and higher computing speed. The new computer has been primarily designed for the small-business application market and it can perform as a general-purpose data-processing machine, an intelligent terminal or a word processor. Software is immediately available for general ledger, accounts receivable, inventory control, mailing-list management and payroll.

The TRS-80 Model II is not intended to replace or obsolete Model I, according to Radio Shack, but to provide capabilities that begin where the original TRS-80 approaches its upper limits. It operates at twice the speed of the original TRS-80. In addition to either 32 or 64K characters (bytes) of internal RAM, Model II has one built-in 8 inch floppy disk that stores an additional one-half million bytes, including the Disk Operating System. It can be expanded to a four disk system for up to two-million bytes of storage.

Model II has a built-in 12 inch high-resolution video monitor that displays 24 lines of 80 normal characters or 40 expanded characters. It features upper and lowercase letters. The 76-key keyboard, with 10-key numeric keypad, includes advanced functions such as Control, Escape, Caps, Hold, Repeat and two software-programmable Special Function keys. The keyboard is detachable and movable to allow more convenient data entry.

An enhanced Level III version of the TRS-80's popular Level II BASIC language and TRSDOS operating system are automatically loaded in memory when the machine is turned on. In addition, each time the computer is turned on, it thoroughly tests itself to ensure proper operation. The program can appear immediately without any intermediate steps or questions to answer. Direct memory access allows Model II to continue processing during disk transfer operations. All input/output operations are vector-interrupt driven. Model II is priced from $3450 for the 32K one-disk system.

Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102. Reader Service number R17.

PDI Software

Memory Builder, Story Builder

The LFD-800 and the LFD-1000.

System 8813 with double-density mini-diskettes.

Informer 3.

The PE Disk System 4.

and Code Breaker are three new educational games now available for the Apple, PET or TRS-80 Level II from Program Design, Inc., 11 Idar Court, Greenwich CT 06830.

Memory Builder is a Concentration-type game that helps kids improve memory and attention span. Story Builder writes short stories with the child to help improve grammar and vocabulary. Code Breaker gives scrambled messages for players to decode and improves basic writing skills (not available for the TRS-80 Level II). All courses are $13.50.

One additional game, Morse Code, is for the PET only. It turns the PET into a Morse code sounder and gives players practice in decoding messages. It comes with a plug for the computer; the user supplies an inexpensive 6-volt buzzer. Price is $14.95.

Reader Service number P61.

Business System

Informer 3's hardware consists of a Z-80 microprocessor, 48K of RAM, two RS-232 serial interface ports, one parallel interface port, 2K PROM monitor, 8 inch floppy disk and a 24 × 80 character CRT terminal. Software includes floppy BASIC (an extended disk BASIC), diagnostics and basic utilities, which include file copy and disk copy for either single- or multiple-drive systems.

Present business software includes Inventory Management, Payroll, Accounts Payable and Receivable, Word Processing, Customer Mailing List, General Ledger, Program Development and others. The system sells for less than $4000.

Digital Sport Systems, 7th and Elm Streets, West Liberty IA 52776. Reader Service number D58.

X, Y Genesis

X, y Genesis, the first in a series of programmer's aids for the Apple II computer, is a set of Applesoft II BASIC subroutines that helps place points, lines, shapes and labeled x and y axes on the high-resolution graphics screen. The full capabilities of the screen can be realized by incorporating plotting areas smaller than the full screen or placing labels on the screen. The plotting subroutines catch situations in which a drawing goes beyond the edge of a defined plotting area. When the drawing reenters the area, the plotting recommences at the edge.

X, y Genesis does the work and allows a programmer to think in terms of a finished high-resolution screen rather than the techniques for plotting such a screen. This system keeps your BASIC programming short and simple; a programmer can see a simple graph minutes after an idea has occurred.

Other programs included in the system allow the subroutines to be added to an existing program and help create tables of high-resolution shapes. A shape table that includes all the keyboard characters plus some special symbols and demonstration programs is also available.

X, y Genesis was designed to be used on an installation consisting of at least a 32K Apple II computer with an Applesoft II firmware card and a disk drive. Price is $99.95.

Futureworld, 2514 University Drive, Durham NC 27707. Reader Service number F19.

One Megabyte Floppy for PET

The PE Disk System 4 is a full-size 8 inch floppy disk/memory expansion system for the Commodore PET computer. Each 8 inch standard disk drive provides 250K bytes totaling 1 megabyte of on-line mass storage when the system is expanded to a maximum of four drives. The PE Disk System 4 includes a built-in memory expansion in the form of an S-100 bus adapter and a 5-slot S-100 motherboard. S-100 memory and peripherals can be instantly interfaced to the PET.

The PE Disk System 4 floppy disk is fully IBM 3740 compatible allowing data exchange between other computers. The PE Disk System 4 comes complete with KM^3, which allows the user to LOAD, RUN, SAVE and UPDATE programs or data directly or under software control. New release KM^3 allows the user to PRINT, INPUT, OPEN and CLOSE data files directly or under software control.

The PE Disk connects to the PET memory expansion connector, a simple plug-in. With 5-slot S-100 motherboard and expansion chassis and a single 8 inch disk drive, it costs $1495. Additional disk drives are available for $995.

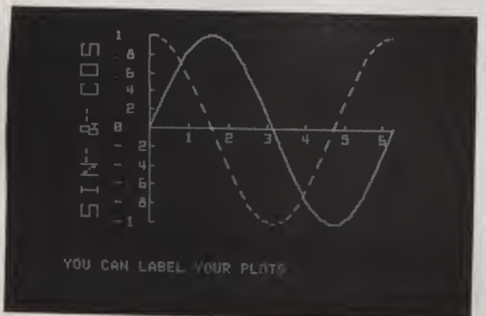
CGRS Microtech, PO Box 368, Southampton PA 18966. Reader Service number C116.

80-Column Printer

The Super Brain Model LP-80 is a bidirectional, dot matrix impact printer with a print head designed for 100 percent duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4 1/2 to 9 1/2 inches wide. A 96 ASCII character set prints in upper and lowercase with the added capability of producing double-width fonts in boldface. The vertical format unit provides preprogrammed/programmable tab positions, top of form and bottom of form for complete formatting capabilities.

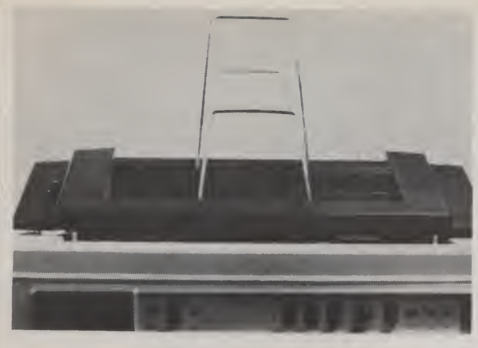
This 80-column printer provides quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125 cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface. Price is $985.

Super Brain, Inc., PO Box 403, Los Angeles CA 90073. Reader Service number S104.

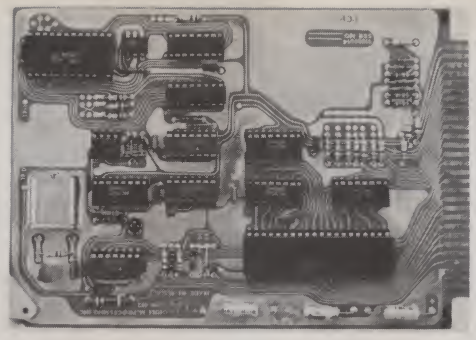


X, y Genesis creates display on Apple II.

The LP-80.



Qume printer cut sheet feeder.



The COM-412.

Cut Sheet Feeder for Qume Printers

A cut sheet (single sheet) feeder for the Qume Sprint 5 daisywheel terminal permits the automatic feeding of up to 200 sheets of 20 pound paper. The unit is lightweight (under 9 pounds) and mounts in the same manner as a conventional forms tractor.

The cut sheet feeder can be easily retrofitted to units already in the field. The unit is interfaced via two intermediate plugs and can be installed in just a few minutes. No separate electrical interface is required.

The cut sheet feeder can handle paper widths of 5 1/2 to 12 inches and lengths of 3 1/2 to 14 inches. Paper out or paper jam are indicated by both visible and audible signals. It is possible to begin printing on the very top of the page to the very bottom of the page. Price is $1390.

COMPUTER TEXTile, 10960 Wilshire Blvd., #1504, Los Angeles CA 90024. Reader Service number C149.

A/D Converter Board

The S-100 A/D board from Tecmar, Inc., 23414 Greenlawn Ave., Cleveland OH 44122, is designed for applications requiring high-speed accurate analog-to-digital conversion including real-time applications. This board interfaces the analogic MP 6812 complete data acquisition system to the S-100 bus. It accepts 16 single-ended inputs and can be used for analog-to-digital conversion for data throughputs up to 30 kHz with 12-bit accuracy and linearity.

The board also provides MUX and sample-hold dynamics and provides two's complement right-justified outputs. The input ranges are ±10 V, ±5 V, 0 to +10 V or 0 to +5 V. The board may be strapped to act as an I/O device (requiring four I/O ports) or to act as a memory-mapped device (requiring four memory locations). Wire-wrap space is provided on the board.

Reader Service number T68.

Interface Card

The COM-412 is a universal receiver and transmitter that performs serial-to-parallel conversions to interface microcomputers with conventional communications equipment. The card provides the circuitry necessary to build computer peripheral controllers, point of sale systems, data acquisition systems, word processors, etc.

This card provides CMOS inputs for TTL and CMOS compatibility as well as low-power consumption. It also features programmable baud rates and data formats. Price is $185.

Giuli Microprocessing, Inc., PO Box 23100, San Jose CA 95153. Reader Service number G32.

Statistics Package

The STATPAK-80 statistics package offers sophisticated statistical manipulation without requiring previous high-level statistical or programming knowledge. The system eliminates the data pre-evaluation often required in existing statistics packages. The STATPAK-80 library contains 35 major functions.

STATPAK-80 is compatible with Microsoft BASIC. STATPAK-80 modules can be interfaced with user software.

Northwest Analytical, PO Box 14430, Portland OR 97214. Reader Service number N25.

Tractor-Feed, Impact Printer

The Model 440 Paper Tiger is a versatile, low-cost impact printer that has software-selectable character sizes, full upper and lowercase 96-character ASCII set, 80-and 132-column formats and the smallest footprint in the industry.

The tractor-feed Paper Tiger combines compactness, flexibility and performance to offer many standard features considered to be extra cost options with other printers. Price is $995.

Integral Data Systems, Inc., 14 Tech Circle, Natick MA 01760. Reader Service number I35.

TRS-80 Encryption Device

Cryptext is a hardware encryption device designed to plug directly into the back of the TRS-80 or into the expansion interface via an optional cable. The Cryptext device allows business users and computer hobbyists to quickly secure virtually any data, including inventory and financial data, technical and proprietary information, graphics, programs or text. The encrypted information can be stored on cassette tapes or on disks, secure against unauthorized access.

Used with a modem, Cryptext allows data or messages to be transmitted by telephone or other communication channels in complete privacy. Other uses include generating pseudorandom numbers for games or scientific programs.

To decode Cryptext-secured data, four elements are essential: the encrypted data, the Cryptext unit, the software and the correct user-supplied key. The lack of any of these elements prevents access to the original data. Data throughput is greater than 15K bytes/second and power consumption is less than 100 milliwatts.

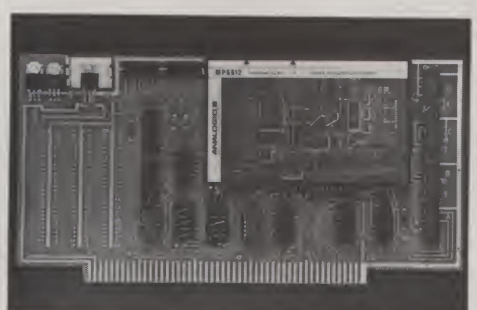
Cryptext is permanently encased in super-tough space-age epoxy and, slightly larger than a cigarette package, it slips easily into pocket or briefcase. It is supplied with demonstration software and user-oriented documentation. Price is less than $300, with optional cable and additional tape or disk software available for an extra charge.

Cryptext Corp., PO Box 425, Northgate Station, Seattle WA 98125. Reader Service number C148.

Global

Global—A Database Management System is a comprehensive and versatile user-oriented database management system for database creation and list maintenance. It runs under CP/M and CBASIC2 on a microcomputer system in 40K RAM. This versa-

(continued on page 23)



S-100 A/D board.

Paper Tiger.

LETTERS

"Banner" Headline

I found several minor errors in Jonathan Rotenberg's super "Ultra Banner" program (March 1979, p. 90). The corrections concern the matrix codes for < and >, and [and], which are reversed. The correct matrix codes are show in Table 1.

I also found that the " is not defined. Its matrix code is ,,BBB where the Bs are blanks. This code goes in line 20 after the fourth comma and before the first asterisk.

Saul G. Levy
Tucson AZ

These bugs are *corrected as Mr. Levy has suggested. I realized after the March issue came out that I had sent in a version of "Ultra Banner" that was slightly older than the current one. The only effect the mistakes will have is to cause the >, <, [,] and " to be incorrectly printed. Most people don't seem to care very much about obscure punctuation, so few seem to have noticed.*

One other correction: Line 240 is completely extraneous and can be deleted. This shouldn't affect operation, other than taking up a few more bytes of memory, unless the program is used at least 100 times consecutively.

I have already processed at least 100 letters and phone calls with questions about "Ultra Banner." Four out of every five of these inquiries are the result of inquirers' typing errors.

People should verify their typing before contacting me. In particular, lines 20-80 must be typed exactly as shown (or letters will appear mutilated), and Vs and Ys must not be confused in lines 330-420 or the program won't run.

I am happy to answer letters and calls to help people with their programming, but it is a real hassle when everybody *calls and writes, when most don't need to.*

One last point: "Ultra Banner" will *run on* any *BASIC-equipped computer as long as the computer has string-handling functions. Some versions of BASIC require a little more modification to the program, however.*

Jonathan Rotenberg
Boston MA

LINE 40, AT END IS 8&!&8 CHANGE THIS TO #,0,#
LINE 50, AT BEGINNING IS #,0,# CHANGE THIS TO 8&!&8
LINE 70, AT BEGINNING IS ?!!!? CHANGE THIS TO ?000?
LINE 80, AT BEGINNING IS ?000? CHANGE THIS TO ?!!!?

Table 1.

HUH Update from HUH

Just a quick note concerning Rod Hallen's review ("HUH?" July 1979, page 40) of our 8100, TRS-80 to S-100 bus adapter.

First, Rod states that his VIO-C "won't find phase I anywhere on the bus." This is certainly not true. Phase I and phase 2 are definitely on the bus and are fully implemented by the 8100.

The relocated version of CP/M that Rod mentions is now available for the Thinker Toys/Morrow Discus 1 system. Contact Thinker Toys, 5221 Central Ave., Richmond CA 94804, (415) 524-2101, for more information.

Also, Rod mentions that an enclosure will be available for the 8100 from another manufacturer. I am pleased to announce that this too is now available, from Integrand, 8474 Ave. 296, Visalia CA 93277, (209) 733-9288. The enclosure alone sells for $125, or is available with a power supply and fan for $185 (the perfect complement to the 8100).

That's it for now.

Mark Garetz
HUH Electronics
San Mateo CA

Making Mods

I enjoyed Allan Domuret's informative June 1979 article, "TRS-80/Selectric Word Processor," and agree with his assessment of the utility of such processors as the Electric Pencil.

In the article he states that unless modified internally "The TRS-80 is . . . deficient because of its uppercase-only capability." Actually, this is partially incorrect. The TRS-80 will print lowercase letters on the Radio Shack (Centronics) Quick Printer when the letters are entered from the keyboard with the shift key depressed, even though the letter is still displayed uppercase on the TV monitor. TRS-80 owners lacking the Quick Printer can demonstrate this lowercase capability by the command PRINT ASC(A). If A is entered without a shift, the computer prints 65, the ASCII code for uppercase A. If A is entered while the shift key is pressed, 97, the ASCII code for lowercase A, is printed, and so on for the other letters.

It would be useful if this lowercase ability could be translated into compatibility with word-processor programs like the Electric Pencil by appropriate software or printer hardware alone. I for one am loath to make internal hardware changes in the TRS-80 for fear that they may introduce unanticipated incompatibility problems in the currently available system and in auxiliary items that Radio Shack will be introducing in the future. This is not an idle concern. For example, when Radio Shack recently introduced buffering in the cable between the keyboard and the expansion interface, they later found that it made their screen printer inoperative, and this in turn necessitated still further cabling modifications of customers' units.

Peter Mazur
Oak Ridge TN

Whose Serve?

In the March 1979 issue of *Microcomputing*, you printed a letter from me regarding the possibility of starting a hobbyist-oriented service bureau. That letter was inspired by Bernard Fehringer's article in the December 1978 issue (p. 30).

Briefly, such a service bureau would provide such services as copying between various formats of cassette, paper tape and other media; printing program listings; assembling programs; and so on.

We prepared a questionnaire in order to find out what people wanted, and these are the results. Eleven people out of about 200 filled out a questionnaire at a computer-club meeting. We left several questionnaires at three computer stores, and apparently nobody filled any out at any of the stores. The letter in *Microcomputing* elicited two responses. The questionnaire was published in the Sol Users Group newsletter, and we got three responses from that.

We have concluded that the demand for these services is not nearly enough for us to be able to buy the required computer equipment. Therefore, at least for now, we will not be starting a hobbyist service bureau.

We would like to thank those who filled out our questionnaire or responded to our letter.

Jim Howell
San Jose CA

From 1710 to 1810

I would appreciate it if you could mention that changing line 430 on page 26 of "Monitor" (June 1979 *Microcomputing*) from GOSUB 1710 to GOSUB 1810 will double the speed of the DUMP routine.

Rod Hallen
Tombstone AZ

A First

As a subscriber, avid reader and promoter of *Microcomputing*, I want to express my appreciation for the excellent article on Technico's Super Starter Kit by Mr. Mataka (July 1979, p. 90).

I have had my Technico TK2-18K TMS 9900 system with 32K of memory for over a year, and this is the first such article of which I am aware to appear in any of the many computer magazines to which I subscribe.

Albert H. Brewster Jr.
Norman OK

Symbolism

Microcomputing for business . . . education . . . FUN! Well, I'm not having any fun tonight! The reason for my less-than-rosy outlook is a recurrent difficulty I have been having in trying to implement published program material on my computer system. I have recently assembled an H11 computer system with dual disk drive mass storage unit, which, as you may know, comes with Benton Harbor BASIC. Perhaps it is obvious that all BASICs are not the same; there are subtle variations between Mits BASIC, TRS-80 BASIC and probably PET BASIC. What with additional confusion between regular BASIC, Extended BASIC and/or Level I and Level II BASIC, it is virtually impossible to take a published program and easily implement it on a new system.

I think that the editors of microcomputing journals could do computer enthusiasts everywhere a lot of good by taking the time to have unusual symbols and functions defined within the articles referring to the programs. What is an unusual symbol? Any symbol that is not part of the symbols originally defined as part of Dartmouth BASIC (that is, the BASIC usually taught in courses) ought to be defined in the article. I'm certain that requiring such definition will take authors a little extra time, but what the heck. The amount of time saved in implementing programs will be much greater in comparison, and that should mean more fun for everyone!

Dr. Vahn A. Lewis
Texas Medical Center
Houston TX

Right, Doc! There is a need for an article (or a series) on the differences in BASICs, perhaps with a chart. This would help programmers who wanted to change programs from one system to another. Look at the difficulty people have been having in rewriting the Osborne Wang BASIC programs into TRS-80-readable programs. Some people have been spending months at this and, as far as I know, only one firm has so far managed the translation with success. Once we have a way of making simple translations of programs from one popular system to another, we'll suddenly have a whole lot more programs available.—Wayne

Tape Is Tape

What in the world is so hard about copying programs from tape? I'm only a 13-year-old computer freak, and could be ignorant about such things as register changing and self-modifying code, but I still think that too much hullabaloo is going on. No matter what "sophisticated methods" there are to protect tape files, a tape is a tape, right? Computer enthusiasts (like myself) seem to have forgotten that what can be done simply digitally can probably also be done by analog (analogically?)!

Making it impossible to list programs or modify them simply hinders the faithful user, not the nasty copier. You must be laughing; I know I would be too, except that I subscribed to *Popular Electronics* (nothing compared to *Microcomputing*, of course) and once was somewhat of an audiophile. Even though I am fully into microcomputing now, I still haven't forgotten my years in audio.

I must stress that I am against the copying of programs (to give away), and have never given away any of my commercially bought programs or taken any copied commercial programs. However, there has been—for years—hardware that would copy *any* data, program or whatnot from one tape to another, despite software "protection." Ever heard of Pioneer?

Mits Hadeishi
(that is my real name)
Los Angeles CA

ISI Booster

I noted with interest Wayne's comments in the July issue about the guy who wouldn't go for Instant Software's deal. I believe you have a lot to offer, and I speak from trying to sell business software on a custom basis. I am with ISI all the way, have submitted a couple of programs, and there will be more. I can not think of a better deal for the independent programmer working out of his home with his own equipment and setting his own hours. Keep up the good work. Distribute those things by the thousands, at $5 or $10 apiece, and we'll all be rich.

Ernie Brooner
Lakeside MT

Success

Your column concerning "Getting the Job" in the June 1979 Publisher's Remarks (p. 24) interested me immensely. Yes, please continue your exposé into the secrets of success. Although experience is the best teacher, I am still curious as to what you learned in your experiences. Considering that I am a high-school senior without a decided destination of education, the subject *may* guide me in the right direction. Yes, I would like to know your secrets of success that are obvious to the vigilant. Incidentally, what prompted you to write such a column?

Ken Rubotzky
Barrington RI

Well, Ken, I got sucked into the college situation like everyone else—it was the thing to do. I wasted four years learning very little, and I'm angry about it. Since then I've thought a lot about what elements are important for success, and I now feel that just about anyone who is really interested can make millions, without college, without any great IQ, without a lot of family money. I realize that 99.9 percent of the readers will read and nod, and go on doing what they have . . . unmoved. But if I can kick 0.1 percent in the butt and get them moving, I'll have helped.—Wayne.

Reach for the Stars!

I just finished reading Wayne's column in the June issue of *Microcomputing*. It was great.

To his words of wisdom, I hereby add my "condensed" philosophy as to why there are so few millionaires. There are four prime reasons: (1) teachers who are poor examples, (2) parents who don't motivate, (3) feeding of one's face and (4) peer pressure.

Who influences and spends the most time with children during their formative years, when personality traits such as motivation, determination and self-esteem are developed? Right, school teachers! Well, even the very few teachers who inspire young people to greatness have a credibility problem. How can a person who has a secure, tenured position, with a salary determined strictly by length of service (not ability or motivation), inspire anyone? Even for those few who do try, it's the old "do as I say, not as I do" problem.

Then we have the parental influence. When's the last time you heard a parent say to a child, "Well, son, the world's at your feet. You can be like me and never work hard (or smart), or take a chance to really get somewhere, or you can reach for the stars."? Under the mask of parental protection, they inspire kids to be just like them. Perhaps the real reason is they are afraid that someday their millionaire children might realize that they weren't so great after all.

Also, the vast majority of people are too busy feeding their faces to sit back and look at the big picture. Finally, and perhaps most important, people are afraid to be different. God forbid you let anyone know you're striving for "the big apple." Gee, what will they say if you fail? Better to hide in the pack, sit back, do your 9-to-5 bit, play it safe, and while you're at it, ridicule anyone else trying to get ahead. After all, if he makes it, it'll make you look bad.

It seems to me, if people spent a little more time working, and less time at the water cooler impressing their peers with how content they are about their lack of achievement, they'd be ten times more successful.

Donald R. Williams, President
Educational Micro Systems, Inc.
Chester NJ

Bulletin!

I am publishing the "TRS-80 Tiny-C and Assembler Programming Bulletin." This publication is directed toward users of Radio Shack's Editor/Assembler and Tiny-C Associates' Tiny-C interpreter for the TRS-80.

The quarterly "Bulletin" is a nonprofit publication intended primarily for the hobbyist. People interested in receiving it should write to me for subscription information.

Rob Varty
2193 Haygate Cr.
Mississauga Ontario
Canada L5K 1L7

PUBLISHER'S REMARKS

(from page 6)

the programs from other publishers. We'd like to know your experience with the various operating systems, with the various languages available for the TRS-80 . . . .

If you've worked out any system using a modem that will automatically call up another TRS-80 and leave a message, write about that quickly.

We're looking for material from games and hobby uses to educational programs, business programs and applications and scientific applications. I keep hearing MIT professors snidely sneering at the TRS-80 and putting it down as a toy—so let's show these IBM people what is and what isn't a toy.

Writing articles is simple. You double space your typing and get cracking at it. We have people what can spell and correct you're grammar. A good picture or a rough drawing is worth a lot, and don't forget the cassette or a program dump on software. Send your material to Wayne Green, *Microcomputing*, Peterborough NH 03458. Hurry.

Career Positions

With a new magazine getting started this fall, there will be several more career positions open at *Kilobaud Microcomputing*. We're looking for people with writing and editing backgrounds, but also with some microcomputer experience.

There is also a need, particularly with Instant Software, for people with strong hobby-computing backgrounds to help with the evaluation of software submitted for publication . . . also for people to help set up and keep microcomputers going, interface various microcomputer systems, test out new products and write them up, etc. Help is also needed from people with advertising, marketing, bookkeeping and accounting experience, and all the other functions involved in a business of some size.

If this sounds good to you, you don't smoke and you'd like to live in one of the very best areas of the entire country, southern New Hampshire, please write and tell us what you've done, what you'd like to do and what you think you might be able to do for us.

COMPUTER CLINIC

(from page 7)

and I would like to obtain the following items or information for the line printer: (1) supplies of magnetic belts, (2) supplies of magnetic toner (INFOREX TM B-L), (3) a toothed-sprocket paper-feeder drive shaft, (4) information on installing and operating a graphics-mode option board.

I am unable to obtain the above items in Australia, or chase up the agents; therefore, I ask your readers for help.

Howard Wills
1/65 Edgar Street North
Glen Iris, Vic. 3146
Australia

I am trying to set up a users group and newsletter for non-MIKBUG 6800-based machines, especially the Capitol Radio Engineering Institute (CREI) and National Radio Institute (NRI) school computers (which are identical). These are based on the Motorola J-Bug (compatible) monitor in the MEK format. I would appreciate any pointers or coverage you could give me.

Mark J. Siebert
2599 Caulfield
San Diego CA 92154

The National Museums of Canada, National Inventory Programme has initiated a project investigating the use of a microcomputer, specifically the Z-80 Sorcerer by Exidy, for museum collections management. This sounds similar to the project discussed by Paul Bunnell in the May 1979 edition of *Kilobaud Microcomputing* (p. 20).

As the National Inventory Programme is a nonprofit service institution, we are interested in sources of software which are, if not free, then inexpensive in exchange for development and application research.

We are also interested in what research has been carried out as to adaptability of software packages, in particular, data-base management and inventory control for museum use.

Jane Milne, Micro Group
National Inventory Programme
National Museums of Canada
240 Bank Street, 6th floor
Ottawa, Ontario K1A 0M8
(613) 996-8501

NEW PRODUCTS

(from page 20)

tile general-purpose tool can be used for diverse applications such as inventory systems, mail lists, indexing collections, history reports, payroll files, accounting files, price lists, client lists, etc.

Features include: completely user-defined file structure with sequential, random and linked file maintenance; user-defined number of fields; data transfer between records; automatic high-speed search algorithms with global search function, built-in ISAM, etc.; fast sort/merge utility. Record-selectable output can be formatted (with/without headings, column titles, totals, etc.) and printed on various forms (labels, envelopes, preprinted forms, etc.).

Global, supplied on standard 8 inch IBM disk, comes complete with BASIC subroutine library supplied in source code and comprehensive manual for $295. Manual alone is $35.

Global Parameters, 1505 Ocean Ave., Brooklyn NY 11230. Reader Service number G33.

Eventide real-time analyzer with PET.

Real-time Audio Spectrum Analyzer

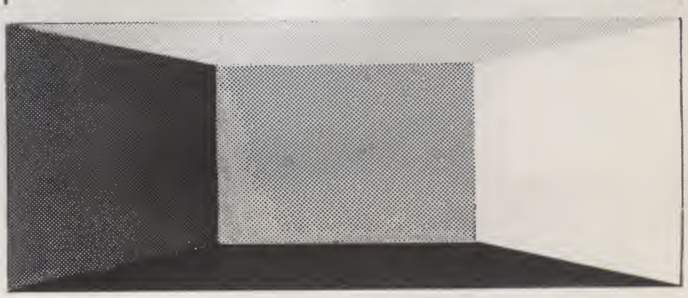
A real-time audio spectrum analyzer designed to fit inside the Commodore PET computer is now available from Eventide Clockworks, Inc., 265 West 54th St., New York NY 10019.

This real-time analyzer divides the audio spectrum from 20 Hz to 20 kHz into 31 third-octave bands and displays those bands, with their relative amplitudes, on the PET screen. The unit can be used for measuring sound and noise levels, for optimizing the equalization of a hi-fi or public address system, for checking the frequency response of audio components and for speech and sound pattern recognition (useful for voice control systems).

With the analyzer, the PET can store and recall spectral data and compare them with past, future or other channel data. There is a PEAK HOLD feature, which enables the unit to determine whether any preset levels have been exceeded. Programs to access the analyzer are written in BASIC; three are provided with the unit: Interactive Operation, Self Test and Minimal Operation.

The analyzer comprises a single circuit board, which installs in about five minutes inside the PET. It has 31 third-octave filters, detectors, an analog-to-digital converter, a 1K Read Only Memory that contains machine-language routines and the necessary peripheral circuitry for transferring data into the PET memory. The board draws its power from the PET transformer. Price is $595.

Reader Service number E49.



Jim Perry
Microcomputing
Projects Editor

A Look at Terminals

This report on video terminals, by** Microcomputing **staff member Jim Perry, tells you what video terminals are and also shows you some that are currently out on the market.

A computer without a video terminal is about as useful as an automobile without a windshield or steering wheel! The computer will run, but is certain to crash—also you won't know where you are. Besides the video terminal, there are other ways of communicating with the inner parts of your computer, but they are either very laborious or more expensive (sometimes both). This article is a quick guide to the wonderful world of terminals, with explanations of what some of the terms mean and what to look for when you go shopping for a terminal.

What Is a Terminal?

So what do people normally mean by the term video terminal, or glass Teletype? Usually these devices consist of a TV-type display and typewriter-style keyboard—the display shows lines of text rather than a normal TV picture and the keyboard is electronically coded to give signals that the computer can understand. More and more computers are being produced with the keyboard as part of the actual computer (such as the TRS-80 and Sorcerer); some even have the display built into the computer (the PET being the most popular example). If you have purchased one with a built-in terminal, then you have the computer equivalent of a music center; separate video terminals are the requirement for computer "separate" installations. Much the same arguments apply to computer-system buying as to hi-fi purchasing; after all, a computer can cost as little (or as much) as a home stereo system.

In general, the computer system with separate video terminal will be put together with an eye toward expansion and will cost more than a comparable system with built-in terminal. One advantage is flexibility; because of industry standards (such as the RS-232 interface) virtually any terminal can communicate with any computer (in theory, at least). So you either need a video terminal or you don't; but even if you don't, it is useful to know about them.

A popular model from the Hazeltine line, the 1500 can be yours for around $995. As with most terminals in this price area, it has many intelligent features plus a separate numeric keypad.

Parlez-vous ASCII?

Internally the CPU (central processing unit) of all computers works with a strange language called machine language, which is rather *unin*telligible to most normal people, since it consists of a lot of high and low voltage levels. However, each different brand of computer uses a different version of the language, i.e., Z-80 machines talk differently than 6800 machines. Since this could cause lots of communication problems, a standard language called ASCII (American Standard Code for Information Interchange) was established. This code is used by virtually all computers; even though they may work differently internally, they all speak ASCII.

When the letter A is pressed on a terminal keyboard, the display also shows A, and the ASCII code for it is sent to the computer. If the computer program responds with the letter X, it does so by giving the terminal the appropriate ASCII code. Without a display you would either be in the dark as to the computer's response or have to interpret the computer's status display (usually a row of LEDs).

Before video terminals became available, the main way to talk to computers was via paper tape, punched cards or teleprinter units. Both paper tape and punched cards required a brain like a computer to understand, and teleprinter units were both exceedingly slow and noisy. Modern video terminals are silent, quick and easy to understand, as the computer output is given in letters and numbers (alphanumeric display).

Early terminals were basically very dumb, hence the phrase "dumb terminal." They had no way of manipulating the data fed to the computer or of interpreting the computer's special commands. With the development of LSI (large-scale integration), the electronics inside the terminals became more sophisticated. As a result, we now have "intelligent" terminals that can manipulate the data and generally make life easier for the computer and operator. More and more terminals are being produced with microprocessors built into them, with a resultant flexibility that was unheard of a few years ago.

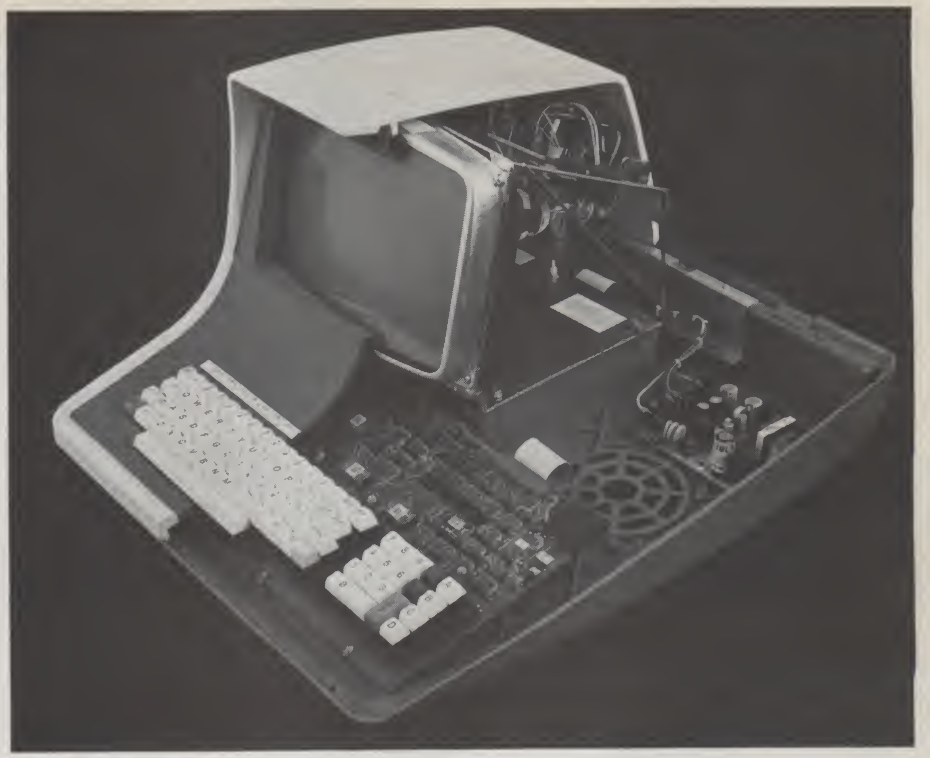
Looks Can Deceive

When it comes to choice of terminal, the number of different specifications can be bewildering; so a basic knowledge of what all the terms mean can be very useful. Since the keyboard looks like a typewriter, a lot of people assume that it will produce both uppercase and lowercase letters—a dangerous assumption. Some terminals do indeed generate the ASCII code for uppercase and lowercase, but a lot of computers can become confused when presented with the lowercase codes (indeed, many manufacturers use them to generate special operations within the computer). On the other hand, the computer may generate a lowercase code when it wants a special graphics character displayed, and the terminal will only produce the normal lowercase letter. It is even more confusing when the terminal generates an oddball character (for example, a diamond shape) when the computer wanted to display a lowercase letter.

Because of the possible problems, it is definitely useful to be able to select how you want the terminal to behave. Most terminals can be set up to automatically convert lowercase input or output into uppercase, thereby preventing problems. Of course, if your computer is happy with lowercase characters, a terminal that can display them is convenient to have, as a mixture of uppercase and lowercase is much easier to read. This is why we have both in the normal world.

While still on the subject of the actual display, we come to the specifications about "graphics characters" and "user definable" keys. Graphics characters are lines and shapes specially designed for drawing graphs and any other alphanumeric pictures on the screen; user-definable keys are for the operator to tell the computer to perform a specific function. For example, you may designate a specific key as a control signal to the computer to stop a program and start a different one instead.

The most common method of generating the actual display is with the aid of ROM (read-only memory) that stores the format for each character as a sequence of dots in a matrix. Everybody has seen how the numbers 0 through 9 can be generated with seven segments on a digital watch; well, the video display has



No, they don't come from the factory like this! This is a cutaway version of the popular Intertec Intertube terminal, clearly showing the unit's electronics. Note that terminals have very few innards compared to a TV set.

The Intertec Data Systems terminal with its cover on. At $874 for a single unit, this terminal has too many facilities to list!

The Southwest Technical Products CT-82 is a relative newcomer to the terminal field, replacing the old favorite CT-64. Priced at $795, this terminal is very intelligent for the money.

characters based on a 5 × 7, 5 × 8 or, sometimes, 8 × 8 matrix. In general, the more dots in the matrix (8 × 8 has 64), the more the display characters will look like normal letters.

The size of the matrix will also be linked to how many characters per line and lines per display can be seen. As an example, the Intertec Intertube terminal uses an 8 × 8 matrix with up to 80 characters per line and a maximum of 25 lines on the screen, whereas the SWTP CT-82 uses a 7 × 12 matrix, with 82 characters per line and up to 20 lines on the screen. SWTP's characters are thinner but deeper.

The more sophisticated terminals have facilities such as reversed letters (black letters on an illuminated background), half brighteners in certain areas and flashing letters—all useful facilities if the terminal is to be used as an input for a lot of data. Anyone who has sat in front of a brightly illuminated display for any length of time knows the advantages of being able to turn down the brightness to alleviate eyestrain and also to prolong the life of the tube. When the same characters are displayed for hours on end in the same screen position—often for weeks on end in some business applications—the tube phosphor (the stuff that actually glows when bombarded with elec-

Price	Model	Manufacturer	Display	Upper/Lowercase	Graphics	Comments
$2595	HT/7	Termiflex, Inc. 17 Airport Rd. Nashua NH 03060	20 × 4	Yes	Yes	Hand held.
$1295	VT4800	VTT Box 60485, Sunnyvale CA 94088	80 × 48	Yes	Yes	Vector graphics as option.
$1295	TLC	Problem Solver Systems Chatsworth CA 91311	80 × 24	Yes	No	Graphics soon.
$995	1500	Hazeltine Corporation Greenlawn NY 11740	80 × 24	Yes	No	
$874	Intertube	Intertec Data Systems 2300 Broad River Rd. Columbia SC 29210	80 × 25	Yes	Yes	
$795	CT-82	Southwest Technical Products 219 W Rhapsody San Antonio TX 78216	82 × 20	Yes	Yes	92 × 22 option.
$695 (kit)	H19	Heath/Schlumberger Benton Harbor MI 49022	80 × 25	Yes	Yes	$995 built.
$649	3360	Telecommunication Services Box 4117 Alexandria VA 22303	82 × 25	Yes	No	Refurbished Datapoint model.
$495	3000	Telecommunication Services Box 4117 Alexandria VA 22303	72 × 25	Yes	No	Refurbished Datapoint model.
$295	VDB-1	F & D Associates 1270 Todd Road New Plymouth OH 45654	80 × 24	Yes	Yes	Board only.
$275 (kit)	OE1000	Otto Electronics Box 3066 Princeton NJ 08540	64 × 16	Yes	No	$350 built, needs video display.
$190 (kit)	RE6416	Ramsey Electronics Box 4072 Rochester NY 14610	64 × 16	Option	No	$249 built, board only.

This sample selection of terminals should enable anyone to find a model that suits his/her needs.

trons) can be literally burned away. So being able to dim the letters that stay on the screen prolongs the terminal's active life!

Crude Commands

A cursor is not an impolite person but, rather, probably one of the most important features of any video terminal. It is usually an illuminated rectangle, the size of one character, that indicates where the next letter is going to appear. Some terminals have flashing cursors; some have continuously illuminated ones; and the best have controllable cursors, which you can make flash when waiting for an input and which can be illuminated while the computer is busy.

Cursor-control facilities enable the user to move the little white square around the screen, back along a line to remove characters or forward to insert spaces. A cursor home key, or command, will send it to the top left of the display. If this facility is present, you will usually get cursor up and down movements as well. Most of the time the cursor-control movements are used in conjunction with the terminal's editing facilities (if it has any, which it should have if it is to be useful). By positioning the cursor over text, you can add to, remove from and generally mutilate anything you have on the display with a few deft keystrokes. The more sophisticated (intelligent) a terminal is, the more complex the editing commands.

One use for all this editing capability is to store your data until you tell the terminal to send it to the computer (so-called block transmit mode), if you have a terminal with internal memory and MPU. With this mode you can type in text and correct it before the computer chokes on all the mistakes you make.

What does a video terminal cost? you may ask! If you want to assemble a basic terminal, using a modified (or even unmodified) TV and do-it-yourself kit, the cost can be as low as $275 for the OE1000 from Otto Electronics (provide your own TV), or as high as $3995 for a hand-held type from Termiflex! In the middle-price range there is a wide selection from $700 to $1000 . . . for this price you get a lot of intellect from the terminal. If you check what your computer needs in the way of a terminal and contact the different manufacturers (use the bingo card at the back of this issue), you should be able to make a decision based on sound judgement, rather than blind faith in a salesperson's chatter. ■

The Termiflex HT/7. Not quite a video terminal in the normal sense. At $2595, it packs a lot of dollars into a small space!

Inventory

Everyone needs to inventory something. This 9-operation program could be what you need.

Richard A. Blessing
22 Sunflower Lane
Fletcher NC 28732

I wrote these programs because I wanted to maintain a list of magazine articles on software for my RCA and North Star systems. As you will see, things got a little out of hand.

The main program, called Inventory, is used to create and maintain a file of character strings. The program can perform nine different operations on a file, besides creating the file or ending the session.

#—returns the total number of records in the file.
A—adds elements to a file.
C—replaces an entry in a file.
E—ends the session.
FS—searches for and prints all occurrences of a string in the file.
I—initializes a file by zeroing the first record in the file. The first record is maintained by all operations that add or remove elements from the file.
L—lists the elements in a file either on the screen or on a Teletype.
LS—prints a listing of the file using a file containing the sorted file pointers generated by a sort.
R—removes elements from a file.
S—calls a sort routine that will sort on any size key, located anywhere within the record.

The program is set up to write and maintain a file of records 62 characters long. This size can be adjusted by changing A3$, B1$ and B2$ to the record size you need. You will also need to change all the random reads and writes. (For example, if you have a record length of 30 characters, line 730 becomes 730 I1 = (I * 32) + 5.)

You must take into account that North Star BASIC adds two characters to each record of 255 characters or less and adds three characters if the record is longer than 255 characters. The 5 is added to offset for the first record, which contains the record count for the file.

You will also need to change the size of A$, D$, C$ and possibly A2$. These strings are all used in the input routine, which starts at line 910 and ends at line 1190. This routine draws a simple format of three fields on my CRT. It also automatically blank-fills each field and moves the cursor along as you hit the return key. You will need an addressable cursor to use this routine. The SIN function is used to create a delay for the OUT calls.

Sort Routines

I have provided two versions of my sort routine: One is written entirely in BASIC; the second version uses a machine-language program to perform the actual sort.

The sort routines never rearrange the records in the file being sorted. Instead, each record is read, and its position in the file and a sort key are stored in corresponding locations in an array or arrays. The sort keys are then compared and, if necessary, swapped along with their corresponding file positons. The technique used is an S/M SORT, which should be easy to recognize in the entirely BASIC version.

There are three character sets you can sort on. If you are sorting character strings of numbers only, the numeric sort will process eight characters per pass and should be used instead of the alphanumeric sort. The alpha sort is for characters only and processes six characters per pass. The alphanumeric sort processes five characters per pass.

At the end of each pass the sort keys are set equal to their location in the sort key array, and, in the case of equal sort keys, they are all set to the lowest value. These old sort keys are then stored in a file called "POINT" by using the file position's array as an index to write the sort keys. If another pass is required, the same procedure up to writing the sort keys is accomplished.

The file "POINT" is then read, and the old sort key is biased by 1000 and added to the new sort key. These sort keys are then sorted and written to "POINT." This process continues until all the characters within the field to be sorted have *been considered*.

The "POINT" file should be (5 * number of records) bytes in

Machine-language sort routine.

```
5BA0 SORTSR
5BA0            ;THIS SUBROUTINE USES A S/M SORT
5BA0            ;TO SORT TWO ARRAYS GENERATED BY
5BA0            ;THE BASIC PGM MACS.
5BA0            N:      DS 2       ;NUMBER OF ITEMS
5BA2            G:      DS 2
5BA4            M1:     DS 2
5BA6 64 47      SKSA:   DW 4764H  ;STARTING ADDRESS OF SORT KEY ARRAY
5BA8 77 DD      FPTA:   DW 0DD77H ;STARTING ADDRESS OF FILE POINTER ARRAY
5BAA            ;
5BAA            ;TEMPORARY STORAGE OF ARRAY ELEMENTS
5BAA            ;
5BAA            T0:     DS 5
5BAF            T1:     DS 5
5BB4            ;
5BB4            ;ADDRESS OFFSETS AND ADDRESS STORAGE
5BB4            ;
5BB4            ADD1:   DS 2
5BB6            ADD2:   DS 2
```

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Now — for hundreds of dollars less than you'd expect to pay — you can add line printer utility and convenience to your Level II TRS-80 system. This top quality impact-type printer doesn't require special paper — you can use inexpensive rolls (available at Radio Shack), continuous forms (original and up to two carbons) or single sheets. The 7x7 dot matrix head prints 50 characters per second; 80 characters on 8 inch lines. Also prints expanded (wider) characters that are ideal for headings under software control. Standard 9½ inch wide continuous forms are kept in perfect alignment by non-adjustable pins on platen. Includes Expansion Interface cable. **26-1154** **$999***

TRS-80 Line Printer II Interface Cable

Now you can attach the Line Printer II directly to your TRS-80 Level II 16K system. No Expansion Interface required unless you plan to add mini disks or more memory. **26-1416** **$59***

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```
5BB8             DUM1:  DS 2
5BBA             DUM2:  DS 2
5BBC             DUM3:  DS 1
5BBD             DUM4:  DS 2
5BBF             ;
5BBF             ;COUNTERS USED TO COMPUTE ARRAY OFFSETS
5BBF             ;I.E. INDEXES
5BBF             ;
5BBF             Y2:    DS 2
5BC1             CNTS:  DS 2
5BC3             ;
5BC3             ;START OF MAIN SORT LOOP
5BC3             ;
5BC3 AF          DIV: XRA A   ;G = G/2
5BC4 3A A2 5B    LDA G
5BC7 1F          RAR
5BC8 32 A2 5B    STA G
5BCB 3A A3 5B    LDA G+1
5BCE 1F          RAR
5BCF 32 A3 5B    STA G+1
5BD2 3A A2 5B    TEST: LDA G  ;TEST G = 0
5BD5 A7          ANA A
5BD6 C2 ED 5B    JNZ SET
5BD9 3A A3 5B    LDA G+1
5BDC A7          ANA A
5BDD C2 ED 5B    JNZ SET
5BE0             ;
5BE0             ;IF G = 0 SORT FINISHED
5BE0             ;RESET G = N AND RETURN
5BE0             ;
5BE0 3A A0 5B    LDA N
5BE3 32 A2 5B    STA G
5BE6 3A A1 5B    LDA N+1
5BE9 32 A3 5B    STA G+1
5BEC C9          RET
5BED 21 BF 5B    SET: LXI H,Y2  ;SET Y2 = 1
5BF0 36 00       MVI M,00H
5BF2 23          INX H
5BF3 36 01       MVI M,01H
5BF5 3A A1 5B    SUB: LDA N+1  ;M1 = N - G
5BF8 21 A3 5B    LXI H,G+1
5BFB 96          SUB M
5BFC 32 A5 5B    STA M1+1
5BFF 3A A0 5B    LDA N
5C02 2B          DCX H
5C03 9E          SBB M
5C04 32 A4 5B    STA M1
5C07             ;
5C07             ;SECONDARY LOOP FOR SORT
5C07             ;SET CNTS = Y2
5C07             ;AND B,C = Y2
5C07             ;
5C07 21 C1 5B    LOOP2: LXI H,CNTS
5C0A 3A BF 5B    LDA Y2
5C0D 77          MOV M,A
5C0E 47          MOV B,A
5C0F 23          INX H
5C10 3A C0 5B    LDA Y2+1
5C13 77          MOV M,A
5C14 4F          MOV C,A
5C15             ;
5C15             ;COMPUTE OFFSETS AND ADDRESSES
5C15             ;
5C15 0B          COMP: DCX B  ;ADJUST TO POINT AT FIRST BYTE
5C16 60          MOV H,B
5C17 69          MOV L,C
5C18 29          DAD H
5C19 29          DAD H
5C1A 09          DAD B
5C1B 7C          MOV A,H
5C1C 32 B4 5B    STA ADD1
5C1F 7D          MOV A,L
5C20 32 B5 5B    STA ADD1+1
5C23 3A A3 5B    LDA G+1
5C26 4F          MOV C,A
5C27 6F          MOV L,A
5C28 3A A2 5B    LDA G
5C2B 47          MOV B,A
5C2C 67          MOV H,A
5C2D 29          DAD H
5C2E 29          DAD H
5C2F 09          DAD B
5C30 3A B5 5B    LDA ADD1+1
5C33 85          ADD L
5C34 32 B7 5B    STA ADD2+1
5C37 3A B4 5B    LDA ADD1
5C3A 8C          ADC H
5C3B 32 B6 5B    STA ADD2
5C3E 3A A7 5B    LDA SKSA+1
5C41 21 B5 5B    LXI H,ADD1+1
5C44 86          ADD M
5C45 32 B9 5B    STA DUM1+1
5C48 3A A6 5B    LDA SKSA
5C4B 2B          DCX H
5C4C 8E          ADC M
5C4D 32 B8 5B    STA DUM1
5C50 3A A7 5B    LDA SKSA+1
5C53 21 B7 5B    LXI H,ADD2+1
5C56 86          ADD M
5C57 32 BB 5B    STA DUM2+1
5C5A 3A A6 5B    LDA SKSA
5C5D 2B          DCX H
5C5E 8E          ADC M
5C5F 32 BA 5B    STA DUM2
5C62             ;
5C62             ;ADD 4 TO EACH ADDRESS AND COMPARE
5C62             ;EXPONENTS
5C62             ;
5C62 21 B9 5B    LXI H,DUM1+1
5C65 5E          MOV E,M
5C66 2B          DCX H
5C67 56          MOV D,M
5C68 21 04 00    LXI H,4
5C6B AF          XRA A
5C6C 19          DAD D
5C6D 7E          MOV A,M
5C6E 32 BC 5B    STA DUM3
5C71 AF          XRA A
5C72 21 BA 5B    LXI H,DUM2
5C75 56          MOV D,M
```

```
5C76 23          INX H
5C77 5E          MOV E,M
5C78 21 04 00    LXI H,4
5C7B 19          DAD D
5C7C 3A BC 5B    LDA DUM3
5C7F BE          CMP M
5C80 CA 89 5C    JZ ZERO
5C83 DA 48 5D    JC THRE
5C86 C3 BA 5C    JMP SWAP
5C89             ;
5C89             ;EXPONENTS WERE EQUAL SO TEST DIGITS
5C89             ;
5C89 21 B8 5B    ZERO: LXI H,DUM1
5C8C 46          MOV B,M
5C8D 23          INX H
5C8E 4E          MOV C,M
5C8F 23          INX H
5C90 56          MOV D,M
5C91 23          INX H
5C92 5E          MOV E,M
5C93 EB          XCHG
5C94 0A          LDAX B
5C95 BE          CMP M
5C96 DA 48 5D    JC THRE
5C99 C2 BA 5C    JNZ SWAP
5C9C 03          INX B
5C9D 23          INX H
5C9E 0A          LDAX B
5C9F BE          CMP M
5CA0 DA 48 5D    JC THRE
5CA3 C2 BA 5C    JNZ SWAP
5CA6 03          INX B
5CA7 23          INX H
5CA8 0A          LDAX B
5CA9 BE          CMP M
5CAA DA 48 5D    JC THRE
5CAD C2 BA 5C    JNZ SWAP
5CB0 03          INX B
5CB1 23          INX H
5CB2 0A          LDAX B
5CB3 BE          CMP M
5CB4 CA 48 5D    JZ THRE
5CB7 DA 48 5D    JC THRE
5CBA             ;
5CBA             ;SWAP ARRAY ELEMENTS
5CBA             ;
5CBA 21 B8 5B    SWAP: LXI H,DUM1
5CBD 46          MOV B,M
5CBE 23          INX H
5CBF 4E          MOV C,M
5CC0 21 AA 5B    LXI H,T0
5CC3 EB          XCHG
5CC4 CD 70 5D    CALL CHANG
5CC7 3A A9 5B    LDA FPTA+1
5CCA 21 B5 5B    LXI H,ADD1+1
5CCD 86          ADD M
5CCE 4F          MOV C,A
5CCF 32 BE 5B    STA DUM4+1
5CD2 3A A8 5B    LDA FPTA
5CD5 2B          DCX H
5CD6 8E          ADC M
5CD7 47          MOV B,A
5CD8 32 BD 5B    STA DUM4
5CDB 21 AF 5B    LXI H,T1
5CDE EB          XCHG
5CDF CD 70 5D    CALL CHANG
5CE2 21 B8 5B    LXI H,DUM1
5CE5 56          MOV D,M
5CE6 23          INX H
5CE7 5E          MOV E,M
5CE8 23          INX H
5CE9 46          MOV B,M
5CEA 23          INX H
5CEB 4E          MOV C,M
5CEC CD 70 5D    CALL CHANG
5CEF 3A A9 5B    LDA FPTA+1
5CF2 21 B7 5B    LXI H,ADD2+1
5CF5 86          ADD M
5CF6 4F          MOV C,A
5CF7 3A A8 5B    LDA FPTA
5CFA 2B          DCX H
5CFB 8E          ADC M
5CFC 47          MOV B,A
5CFD 21 BD 5B    LXI H,DUM4
5D00 56          MOV D,M
5D01 23          INX H
5D02 5E          MOV E,M
5D03 CD 70 5D    CALL CHANG
5D06 21 BA 5B    LXI H,DUM2
5D09 56          MOV D,M
5D0A 23          INX H
5D0B 5E          MOV E,M
5D0C 01 AA 5B    LXI B,T0
5D0F CD 70 5D    CALL CHANG
5D12 3A A9 5B    LDA FPTA+1
5D15 21 B7 5B    LXI H,ADD2+1
5D18 86          ADD M
5D19 5F          MOV E,A
5D1A 3A A8 5B    LDA FPTA
5D1D 21 B6 5B    LXI H,ADD2
5D20 8E          ADC M
5D21 57          MOV D,A
5D22 01 AF 5B    LXI B,T1
5D25 CD 70 5D    CALL CHANG
5D28 21 A3 5B    LXI H,G+1
5D2B 3A C2 5B    LDA CNTS+1
5D2E 96          SUB M
5D2F 32 C2 5B    STA CNTS+1
5D32 4F          MOV C,A
5D33 2B          DCX H
5D34 3A C1 5B    LDA CNTS
5D37 9E          SBB M
5D38 32 C1 5B    STA CNTS
5D3B 47          MOV B,A
5D3C DA 48 5D    JC THRE
5D3F C2 15 5C    JNZ COMP
5D42 3E 00       MVI A,00H
5D44 B9          CMP C
5D45 DA 15 5C    JC COMP
5D48             ;
```

```
5D48                ;INCREMENT Y2 BY 1
5D48                ;THEN TEST TO SEE IF
5D48                ;Y2 > M1
5D48                ;
5D48 3A BF 5B       THRE: LDA Y2
5D4B 57             MOV D,A
5D4C 3A C0 5B       LDA Y2+1
5D4F 5F             MOV E,A
5D50 13             INX D
5D51 7A             MOV A,D
5D52 32 BF 5B       STA Y2
5D55 7B             MOV A,E
5D56 32 C0 5B       STA Y2+1
5D59                ;
5D59                ;TEST Y2 > M1
5D59                ;
5D59 21 A4 5B       LXI H,M1
5D5C 7A             MOV A,D
5D5D BE             CMP M
5D5E DA 07 5C       JC LOOP2
5D61 C2 C3 5B       JNZ DIV
5D64 7B             MOV A,E
5D65 23             INX H
5D66 BE             CMP M
5D67 DA 07 5C       JC LOOP2
5D6A CA 07 5C       JZ LOOP2
5D6D C3 C3 5B       JMP DIV
5D70                ;
5D70                ;SUBROUTINE LOADS DATA ADDRESSED BY
5D70                ;B,C INTO MEMORY ADDRESSED BY H,L
5D70                ;
5D70 EB             CHANG: XCHG
5D71 0A             LDAX B
5D72 77             MOV M,A
5D73 23             INX H
5D74 03             INX B
5D75 0A             LDAX B
5D76 77             MOV M,A
5D77 23             INX H
5D78 03             INX B
5D79 0A             LDAX B
5D7A 77             MOV M,A
5D7B 23             INX H
5D7C 03             INX B
5D7D 0A             LDAX B
5D7E 77             MOV M,A
5D7F 23             INX H
5D80 03             INX B
5D81 0A             LDAX B
5D82 77             MOV M,A
5D83 EB             XCHG
5D84 C9             RET
```

```
10 INPUT"NAME OF FILE TO SORT ",A1$
20 INPUT "RECORD FIELD TO SORT ON ",B,F
30 OPEN#0,A1$\READ#0,T1\CLOSE #0
40 DIM P(T1,1),R$(62)
50 INPUT"TYPE OF SORT?, ALPHA =A, ALPHA & NUM =AN, NUM =N ",A$
60 A1=4\A2=7\A3=5\A4=6\A6=42\IF A$="AN" THEN 90
70 IF A$="A" THEN 80 ELSE 580
80 A1=5\A2=5.4\A3=6\A4=7\A5=3\A6=61
90 S=(E-B)+1\P=INT(S/A3+.9)\P2=0
100 FOR I=0 TO A1\X(I)=A2↑(2*I)\NEXT
110 IF P>1 THEN N=A3 ELSE N=S-(A3*INT(S/A4))
120 Y=0\OPEN #0,A1$\READ #0,T1
130 READ #0,R$\Y=Y+1\P(Y,0)=0\P(Y,1)=Y\I1=0
140 FOR I=B TO N+B-1\K=(A1-I1)\I1=I1+1
150 R=ASC(R$(I,I))\IF R<48 THEN 160\R=R-A6\GOTO170
160 R=0
170 P(Y,0)=P(Y,0)+R*X(K)\NEXT
180 IF Y<T1 THEN 130 ELSE CLOSE #0\B=B+N
190 REM START S / M SORT
200 Y1=Y
210 Y1=INT(Y1/2)\IF Y1=0 THEN 330
220 Y2=1\Y3=Y-Y1
230 Y4=Y2
240 Y5=Y4+Y1
250 IF P(Y4,0)<=P(Y5,0)THEN 300
260 T=P(Y4,0)\T0=P(Y4,1)\P(Y4,0)=P(Y5,0)\P(Y4,1)=P(Y5,1)
270 P(Y5,0)=T\P(Y5,1)=T0
280 Y4=Y4-Y1
290 IF Y4>=1 THEN 240
300 Y2=Y2+1
310 IF Y2>Y3 THEN 210
320 GOTO 230
330 IF P2<>0 THEN 440 \ P2=1
340 O1=0\N1=0
350 FOR I=1 TO Y
360 N1=P(I,0)\IF N1<>O1 THEN 380
370 O1=N1\P(I,0)=P((I-1),0)\GOTO 390
380 O1=N1\P(I,0)=I
390 NEXT
400 OPEN #0,"POINT"\FOR I=1TO Y
410 WRITE #0 %((P(I,1))-1)*5,P(I,0),NOENDMARK
420 NEXT\CLOSE #0\P=P-1
430 P3=P3+1\!P3\IF P<=0 THEN 530 ELSE IF A$<>"N" THEN 120 ELSE 580
440 P2=0\N1=0\O1=0
450 FOR I=1 TO Y
460 N1=P(I,0)\IF N1<>O1 THEN 480
470 O1=N1\P(I,0)=P((I-1),0)\GOTO 490
480 O1=N1\P(I,0)=I
490 NEXT
500 OPEN #0,"POINT"\FOR I=1 TO Y
510 READ #0 %((P(I,1))-1)*5,P5\P(I,0)=P(I,0)+(1000*P5)
520 NEXT\CLOSE #0\GOTO190
530 INPUT "DO YOU WANT LIST ON TTY?",H$
540 IF H$="YES" THEN Q=1 ELSE Q=0
550 OPEN #0,A1$\READ #0,T\FOR I=1 TO Y\R=P(I,1)-1
560 READ #0 %(R*64)+5,R$\!#Q,R,TAB(5),R$\NEXT\CLOSE #0
570 CHAIN "INVENTRY"
580 S=(E-B)+1\P=INT(S/8+.9)\P2=0
590 IF P>1 THEN N=8 ELSE N=S-(8*INT(S/9))\I1=0
600 Y=0\OPEN #0,A1$\READ #0,T1
610 READ #0,R$\Y=Y+1\P(Y,0)=0\P(Y,1)=Y
620 P(Y,0)=VAL(R$(B,B+N-1))
630 IF Y<T1 THEN 610 ELSE CLOSE #0\B=B+N
640 GOTO 190
```

BASIC sort routine.

length. Thus, for 1000 records "POINT" would have a size of 5000 bytes. This method allows you to store several sorted versions of a file in a much smaller amount of mass storage than the individually sorted record files would take.

If you use the machine-language version of the sort, you will need to reset ENDBAS to 5E00H and load the subroutine in 5BA0H through 5D84H. The two addresses, SKSA and FPTA, are the locations of P(1) and P1(1), respectively. If you change the BASIC program or the size of the arrays, you will need to adjust these values.

I found their locations by starting the program then doing a CTRL-C and setting a value I could easily recognize into P(1) and P1(1). I then exited to *the* monitor M2AOO and searched memory until I found the locations in memory. The program is set to sort up to 1000 records. If you change this number you will also need to increase the number in line 410 used to bias the old sort key. Changing it to 10000 would allow you to sort up to 10,000 records.

Using this routine I can sort 320 62-character records on a 24-character field in about 11 minutes. The same file sorted on a five-character alphanumeric field, six-character alphabetic field or eight-character numeric field takes about 2 1/2 minutes.

These times are from execution on a North Star Horizon I with 16K dynamic RAM, 24K static RAM, an Otto OEM-1000, TVT and a KSR-33 TTY. Everything except the Teletype was assembled from kits.

I have nothing but praise for both North Star and Godbout. All of the hardware has performed error-free under almost daily usage. I also praise S-100 for extremely quick delivery of the kits I have ordered.

One other plaudit: Supersoft's ARIAN system is an excellent system for writing assembly-language programs. I had been using another company's assembler/editor and wish I had purchased the ARIAN system first. I liked it so much I have ordered their Tiny PASCAL. They also provide rapid delivery.■

Program listing.

```
10 DIM A$(22),A2$(22),A3$(62),D$(20),C$(20),P(500),B1$(62),B2$(62)
20 DEF FNA(B1$,B2$,K)
30 FOR I=1 TO (LEN(B2$)-LEN(B1$)+1)
40 IF B1$(1,1)<>B2$(I,I) THEN 70
50 IF B1$<>B2$(I,(I+LEN(B1$)-1)) THEN 70 ELSE ! K,"  ",B2$
60 RETURN D
70 NEXT\GOTO60
80 FNEND
90 A2$="                                        "
100 ! TAB(10),"INVENTORY PROGRAM"
110 !\INPUT "TYPE IN THE NAME OF THE FILE YOU WISH TO UPDATE ",A1$
120 T = FILE(A1$)
130 IF T<>-1 THEN 190
140 !"FILE DOES NOT EXIST - DO YOU WISH TO CREATE IT ?"
150 INPUT K$\IF K$="NO" THEN END
160 INPUT "FILENAME ",A1$\INPUT "LENGTH ",K\ERRSET 180,K1,K2
170 CREATE A1$,K\GOTO 190
180 !"FILE LENGTH TOO LARGE ! "\GOTO 160
190 !\! "SELECT A COMMAND FROM THE FOLLOWING AND ENTER IT."\!\!
200 PRINT " LIST THE FILE - 'L'"
210 PRINT " INITIALIZE A NEW FILE - 'I'"
220 PRINT " REMOVE AN ITEM - 'R'"
230 PRINT " ADD ITEMS - 'A'"
240 PRINT" SORT ITEM LIST - 'S'"
250 PRINT" LIST A SORTED FILE - 'LS'"
260 PRINT " NUMBER OF ITEMS IN FILE - '#'"
270 PRINT " CHANGE AN ENTRY - 'C'"
280 PRINT " END PROGRAM - 'E'"
290 PRINT " FIND STRING - 'FS'"
300 !\!\!
310 INPUT A$
320 IF A$="I" THEN 450
330 IF A$ = "L" THEN 490
340 IF A$="R" THEN 670
350 IF A$="C" THEN 840
360 IF A$="A" THEN 880
370 IF A$="LS" THEN 1200
380 IF A$="S" THEN CHAIN "MACS"
390 IF A$="E"  THEN END
400 IF A$ = "FS" THEN 1280
410 IF A$(1,1)<>"#" THEN 440
420 OPEN #0,A1$\READ #0,T\CLOSE #0\!"THERE ARE ",T," ITEMS."
430 GOTO310
440 PRINT "IMPROPER REQUEST  TRY AGAIN"\GOTO 190
450 OPEN #0,A1$
460 Z =0 \WRITE #0,Z,NOENDMARK
470 CLOSE #0
480 GOTO 640
490 PRINT "DO YOU WANT LISTING ON THE TTY ?"
500 INPUT "YES OR NO ",A$
510 IF A$(1,1)="Y" THEN O1=1 ELSE O1=0
520 OPEN #0,A1$
530 READ #0,T
```

```
540 !\!\!
550 PRINT "THERE ARE ",T," ITEMS IN THE FILE."
560 !\!\!
570 IF T=0 THEN 620
580 FOR I = 1 TO T
590 READ #0,A3$
600 PRINT  #01,I," ",A3$
610 NEXT I
620 CLOSE #0
630 !\!\!\!
640 PRINT "TYPE IN NEXT COMMAND OR ? IF YOU WANT"
650 PRINT "THE LIST OF COMMANDS AGAIN."
660 INPUT A$\IF A$="?" THEN 190 ELSE 320
670 OPEN #0,A1$
680 READ#0,T
690 CLOSE #0
700 INPUT "WHAT # ITEM DO YOU WISH TO REMOVE ?",R
710 OPEN #0,A1$
720 FOR I = R TO (T-1)
730 I1 = ( I*64)+5
740 READ #0 %I1,A3$
750 I1=I1-64
760 WRITE #0 %I1,A3$,NOENDMARK
770 NEXT I
780 CLOSE #0
790 T=T-1
800 OPEN #0,A1$
810 WRITE #0,T,NOENDMARK
820 CLOSE #0
830 GOTO 620
840 INPUT "ENTER ENTRY #",T\OPEN #0,A1$\T=T-1
850 READ #0 %(64*T)+5,A3$\!T+1," ",A3$
860 CLOSE #0\!"TYPE IN NEW LINE"\!\!\E1=1
870 GOTO 940
880 OPEN #0,A1$
890 READ #0,T
900 CLOSE #0
910 !\PRINT "WHEN DONE ENTER 'DONE' FOR ITEM NAME."\!\!
920 !"IF YOU WANT TO ERASE AN ENTRY, ENTER A '*' AS THE"
930!"LAST CHARACTER IN THE LAST FIELD."\!\!\!
940!":                    :                    :"
950 !\!\!\!\!
960 FOR I=1 TO 6\OUT 2,11\Z=SIN(90)\NEXT
970 OUT 2,9\Z=SIN(90)\INPUT1 " ",A$
980 IF A$="DONE" THEN 800
990 X=24-LEN(A$)\A$=A$+A2$
1000 FOR I =1 TO X\OUT 2,9\Z=SIN(90)\NEXT I
1010 INPUT1"",C$
1020 X=19-LEN(C$)\C$=C$+A2$
1030 FOR I=1 TO X\OUT 2,9\Z=SIN(90)\NEXT I
1040 INPUT " ",D$
1050 IFLEN(D$)=0 THEN 1080
1060 IF D$(LEN(D$),LEN(D$))<>"*" THEN 1080
1070 OUT 2,5\Z=SIN(90)\GOTO970
1080 D$=D$+A2$
1090 K=(T*64)+5
1100 OUT 2,5\Z=SIN(90)
1110 A3$=A$+C$+D$+A2$
1120 OPEN #0,A1$
1130 IF E1=0 THEN WRITE #0 %K,A3$ ELSE WRITE #0 %K,A3$,NOENDMARK
1140 CLOSE #0
1150 IF E1<>1 THEN 1160 ELSE E1=0\!\!\GOTO640
1160 T=T+1\T0=T0+1\IF T0<5 THEN 970 ELSE T0=0
1170 OPEN #0,A1$
1180 WRITE #0,T,NOENDMARK
1190 CLOSE #0\GOTO970
1200 Q=0
1210 INPUT"DO YOU WANT LISTING ON TTY ?",H$\IF H$="YES"THEN Q = 1
1220 OPEN #0,A1$\READ #0,Y
1230 OPEN #1,"POINT"\FOR I=1TOY
1240 READ #1,P(I)\NEXT\CLOSE #1
1250 FOR I=1TOY
1260 READ #0 %(P(I)-1)*64+5,R$\!#Q,P(I),TAB(5),R$\NEXT\CLOSE #0
1270 GOTO640
1280 INPUT "TYPE IN STRING ",B1$
1290 OPEN #0,A1$\READ #0,T
1300 FOR K=1 TO T\READ #0,B2$
1310 D=FNA(B1$,B2$,K)\NEXT\CLOSE #0\GOTO 640
```

ON X GOSUB VVVV,TTTT

This metric and English equivalents program is built around a little-used TRS-80 routine.

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When you first start out to become a programmer, there is the usual tendency to stick to the book. After all, who knows more about this computer than its mother? When the apron strings are cut, you turn to the advice of friends—be they people or periodicals—to upgrade your repertoire and your skills. If it is true that this latter step molds you more strongly than the book, it may be one reason why I personally see so little use of the following TRS-80 routine:

ON D GOSUB Line #,Line #, Line # . . . etc.

Fundamentally, this routine lets you set up a table or list of subroutines that may be selectively called or implemented by selecting an appropriate integer value for D. To illustrate the use of this BASIC utility, I have written a simple program that will give you selected metric/English and English/metric equivalents (see program listing).

Lines 10 through 16 create the billboard or menu that gives you guidance on how to utilize the program. Lines 120 through 170 contain the information that allows the computer to operate upon your input value and return the desired information. Line 60 is the entry point to the proper line in the subroutine listing. Note that the double comma in line 14 is needed to properly format this line of print in the billboard.

You may use an alternative for line 70:

70 INPUT"PRESS ENTER TO CONTINUE"; B$

This will hold the answer on the screen for as long as you wish. Then if you wish to perform another calculation, merely press ENTER, and the screen will clear the old information and reestablish the billboard.

When you run the program, the billboard will appear along with a request to input your value to be converted. When you have entered this value, the program will then ask you to input a number value from the billboard to indicate what function you wish performed. For instance, if you wanted the input value in gallons to be changed to liters, then you would input 5 as the operations number. The computer would then go to the fifth subroutine in the list (line 160), operate on your input value and return the answer.

It is obvious that the limit of the number of conversions you can program is only in your imagination and your willingness to type up the desired program. If you have not practiced programming with this routine, do so, as it will give your programs a newfound flexibility. ■

```
5 CLS
10 PRINT @ 4,"METRIC CONVERSION OPERATIONS NUMBERS"
12 PRINT @ 64,"1 = YDS TO METERS","2 = METERS TO YDS"
14 PRINT @ 128,"3 = INCHES TO CM",,"4 = CM TO INCHES"
16 PRINT @ 192,"5 = GALLONS TO LITERS","6 = LITERS TO GALLONS"
20 PRINT:PRINT:PRINT:PRINT
40 INPUT"FIRST VALUE";C
50 INPUT"OPERATIONS NUMBER";D
60 ON D GOSUB 120,130,140,150,160,170
65 PRINT C
70 FOR J = 1 TO 1500: NEXT J
80 GOTO 5
120 C = C* .9114:RETURN
130 C = C* 1.0936:RETURN
140 C = C* 2.54:RETURN
150 C = C* .3937:RETURN
160 C = C* 3.785:RETURN
170 C = C* .2642:RETURN
```

Program listing.

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PIE TEXT EDITOR

PIE (PROGRAMMA IMPROVED EDITOR) is a two-dimensional cursor-based editor designed specifically for use with memory-mapped and cursor-based CRT's. It is totally different from the usual line-based editors, which were originally designed for Teletypes. The keys of the system input keyboard are assigned specific PIE Editor function commands. Some of the features included in the PIE system are: Blinking Cursor; Cursor movement up, down, right, left, plus tabs; Character insert and delete; String search forwards and backwards; Page scrolling; GOTO line number, plus top or bottom of file; Line insert and delete anywhere on screen; Move and copy (single and multiple lines); Append and clear to end of line; Efficient memory usage. The following commands are available in the PIE Text Editor and each is executed by depressing the systems argument key simulataneously with the command key desired:

[LEFT]	Move cursor one position to the left
[RGHT]	Move cursor one position to the right
[UP]	Move cursor up one line
[DOWN]	Move cursor down one line
[BHOM]	Home cursor in lower left left hand corner
[HOME]	Home cursor in upper left hand corner
[-PAG]	Move up (toward top of file) one "page"
[+PAG]	Move down (toward bottom of file) one "page"
[LTAB]	Move cursor left one horizontal tab
[RTAB]	Move cursor right one horizontal tab
[GOTO]	Go to top of file (line 1)
[ARG]n[GOTO]	Go to line 'n'
[BOT]	Go to bottom of file (last line + 1)
[-SCH]	Search backwards (up) into file for the next occurence of the string specified in the last search command
[ARG]t[-SCH]	Search backwards for string 't'
[+SCH]	Search forwards (down) into the file for the next occurence of the string specified in the last search command
[ARG]t[+SCH]	Search forward for string 't'
[APP]	Append -move cursor to last character of line +1
[INS]	Insert a blank line beforere the current line
[ARG]n[INS]	Insert 'n' blank lines before the current line
[DEL]	Delete the current line, saving it in the "push" buffer
[ARG]n[DEL]	Delete 'n' lines and save the first 20 in the "push" buffer
[DBLK]	Delete the current line as long as it is blank
[PUSH]	Save current line in "push" buffer
[ARG]n[PUSH]	Save 'n' lines in the "push" buffer
[POP]	Copy the contents of the "push" buffer before the current line
[CINS]	Enable character insert mode
[CINS] [CINS]	Turn off character insert mode
[BS]	Backspace
[GOB]	Gobble - delete the current character and pull remainder of characters to right of cursor left one position
[EXIT]	Scroll all text off the screen and exit the editor
[ARG] [HOME]	Home Line - scroll up to move current line to top of screen
[APP] [APP]	Left justify cursor on current line
[ARG] [GOB]	Clear to end of line

Apple PIE Cassette	**16K**	**$19.95**
TRS-80PIE Cassette	**16K**	**19.95**
Apple PIE Disk	**32K**	**24.95**

6502FORTH · Z-80FORTH 6800 FORTH

FORTH is a unique threaded language that is ideally suited for systems and applications programming on a micro-processor system. The user may have the interactive FORTH Compiler/Interpreter system running stand-alone in 8K to 12K bytes of RAM. The system also offers a built-in incremental assembler and text editor. Since the FORTH language is vocabulary based, the user may tailor the system to resemble the needs and structure of any specific application. Programming in FORTH consists of defining new words, which draw upon the existing vocabulary, and which in turn may be used to define even more complex applications. Reverse Polish Notation and LIFO stacks are used in the FORTH system to process arithmetic expressions. Programs written in FORTH are compact and very fast.

SYSTEM FEATURES & FACILITIES

Standard Vocabulary with 200 words
Incremental Assembler
Structured Programming Constructs
Text Editor
Block 1/0 Buffers
Cassette Based System
User Defined Stacks
Variable Length Stacks
User Defined Dictionary
Logical Dictionary Limit
Error Detection
Buffered Input

CONFIGURATIONS

AppleFORTH Cassette 16K	**$34.95**
AppleFORTH Disk 32K	**49.95**
PetFORTH Cassette 16K	**34.95**
TRS-80FORTH Cassette 16K	**34.95**
SWTPCFORTH Cassette 16K	**34.95**

ASM/65 EDITOR ASSEMBLER

ASM/65 is a powerful, 2 pass disk-based assembler for the Apple II Computer System. It is a compatible subset of the FORTRAN cross-assemblers which are available for the 6500 family of micro-processors. ASM/65 features many powerful capabilities, which are under direct control of the user. The PIE Text Editor co-resides with the ASM/65 Assembler to form a comprehensive development tool for the assembler language programmer. Following are some of the features available in the ASM/65 Editor Assembler.

- PIE Text Editor Command Repetoire
- Disk Based System
- Decimal, Hexadecimal, Octal, & Binary Constants
- ASCII Literal Constants
- One to Six character long symbols
- Location counter addressing "*"
- Addition & Subtraction Operators in Expressions
- High-Byte Selection Operator
- Low-Byte Selection Operator
- Source statements of the form: [label] [opcode] [operand] [;comment]
- 56 valid machine instruction mnemonics
- All valid addressing modes
- Equate Directive
- BYTE Directive to initialize memory locations
- WORD Directive to initialize 16-bit words
- PAGE Directive to control source listing
- SKIP Directive to control source listing
- OPT Directive to set select options
- LINK Directive to chain multiple text files
- Comments
- Source listing with object code and source statements
- Sorted symbol table listing

CONFIGURATION

Apple II	**48K/Disk**	**$69.95**

LISA INTERACTIVE ASSEMBLER

LISA is a totally new concept in assembly language programming. Whereas all other assemblers use a separate or co-resident text editor to enter the assembly language program and then an assembler to assemble the source code, LISA is fully interactive and performs syntax/addressing mode checks as the source code is entered in. This is similar in operation to the Apple II Integer BASIC Interpreter. All error messages that are displayed are in plain, easy to understand English, and not simply an Error Code. Commands in LISA are structured as close as possible to those in BASIC. Commands that are included are: LIST, DELETE, INSERT, PR #n, IN #n, SAVE, LOAD, APPEND, ASM, and a special user-defineable key envisioned for use with "dumb" peripherals. LISA is DISK II based and will assemble programs with a textfile too long to fit into the Apple memory. Likewise, the code generated can also be stored on the Disk, hence freeing up memory for even larger source programs. Despite these Disk features, LISA is very fast; in fact LISA is faster than most other commercially available assemblers for the Apple II. Not only is LISA faster, but also, due to code compression techniques used LISA requires less memory space for the text file. A full source listing containing the object and source code are produced by LISA, in addition to the symbol table

Apple II 32K/Disk $34.95

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PROGRAMMA Software Products

Ron Fracchia
634 Harvard Ave.
Baldwin NY 11510

It's Time for Core

A hard-core computerist's memory vigil pays off. Now you can learn more about core.

The computer hobbyist seeking to expand the memory capability of his machine is faced with so many potential sources of RAM and ROM that it's often a difficult task to make a choice. Knowing that commercial and military minicomputers use a nonvolatile magnetic core memory, I've been waiting for the day when core would start to show up on the personal computer scene.

Recently, my patience paid off. Several large manufacturers are now offering 8K and 16K core memories for use with the 8080. Additionally, a New Jersey computer surplus dealer is currently featuring several varieties of core. While the cost of core directly from the manufacturers is still three or four times that of the equivalent amount of solid-state memory, the surplus price is essentially the same as RAM, in some cases less!

The boards I chose were surplus Ampex core memories complete with read/write and addressing electronics. Built by Ampex for use in a commercial minicomputer, they are available in new condition from Electravalue Industrial, PO Box 157, Morris Plains NJ 07950. Price, fully tested with documentation, is \$150 for 8K × 8 and \$325 for 16K × 8, UPS shipping paid. The price includes a 16-page detailed product specification. A large set of schematics is also available for \$4 extra.

Of the several types of core memory available from Electravalue, the Ampex core is clearly the easiest to interface to an 8-bit machine. After getting a copy of the product specification, I studied the power requirements and timing diagrams. It began to appear that this core would be a natural for use with an S-100 machine; it almost seemed as if they were designed for each other. Although the nominal cycle time of the core is 1200 ns, the timing signals are such that with a 2 MHz clock the CPU will run without any wait states.

When my 16K core memory assembly arrived, I was quite pleased. Although the cores are being sold as surplus, my unit arrived in the original Ampex box and appeared to be brand new. The date codes on the schematics and components implied that the units had been manufactured during or after 1974, and the technology utilized reflects this.

The core consists of two boards, one mounted above the other, supported by metal standoffs and electrically connected by finger-type contacts located around the sides of the boards. This makes it easy for curious persons to disassemble the unit.

The actual core planes are located between the two boards, protected by a metal shield still bearing the original unbroken anti-tamper seals. The lower board has two groups of edge connector fingers on one end, address selector switches on the other end and many 7400 series ICs, along with some transistors and resistors. The edge connector fingers match standard, dual, 22-contact edge connectors.

The upper board is an impressive collection of ICs (7400 and 75000 series, mainly Texas Instruments) and a number of diodes. The layout, schematics and availability of parts should make this a very serviceable unit.

The 16K core board consists of two 8K blocks of memory that can be addressed separately. The address-selection switches allow each block to be placed on any 8K memory boundary in a 64K system (see Fig. 1).

TO ADDRESS	PUSH		
0000 - 1FFF	1	2	4
2000 - 3FFF		2	4
4000 - 5FFF	1		4
6000 - 7FFF			4
8000 - 9FFF	1	2	
A000 - BFFF		2	
C000 - DFFF	1		
E000 - FFFF	-	-	-

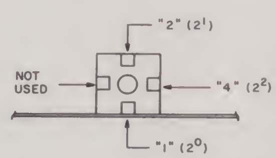


Fig. 1. The core assembly address-selection switch. Address selection is made by closing contacts as shown in the table. Note that a 16K board has two switches and is addressable as two independent 8K blocks of memory. The address selector block is located at the rear of the unit (side opposite the edge connector) on the lower board.

Theory

By reading the product specification, I could see that the core assembly would operate in three different modes: the read/restore mode, the read/modify/write mode and the clear/write mode. Since the data in a physical magnetic core toroid is always destroyed when that core is read, it is necessary to rewrite it back into the same location after reading it. That is done automatically in the read/restore cycle. The read/modify/write and the clear/write modes do just exactly what their names imply.

I could also see that the decision as to which mode was to be used had to be made early in the core cycle. Since the 8080 doesn't tell the outside world what it is going to do (read, write, input, output, etc.) until 500 ns after the start of its *instruction cycle*, I decided to initiate a core read/modify/write cycle near the start of every 8080 cycle and then control the flow of data within the interface

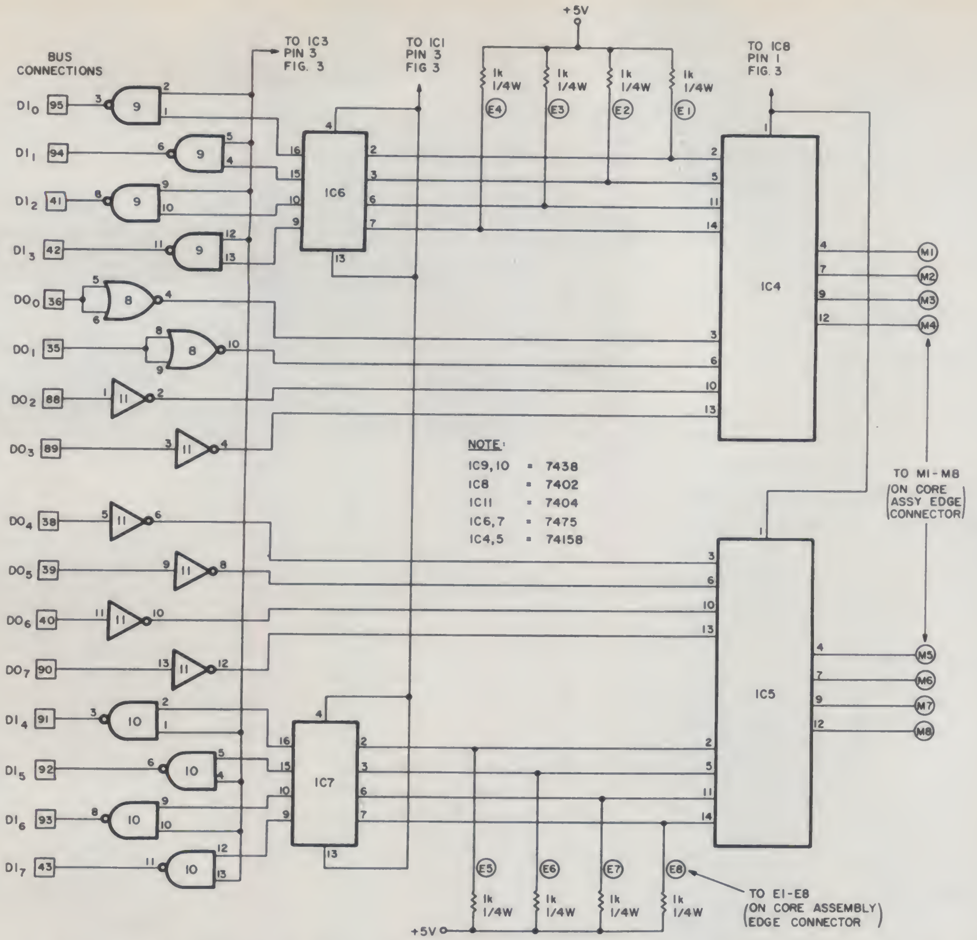


Fig. 2. The data lead switching portion of the S-100 interface. The M and E leads go to the core assembly edge connector, and the data leads on the left go to the S-100 bus lands on the Vector 8800V prototype board.

IC	Part Number	+5 V	GND
1	74123	16	1,8,9
2	74123	16	8,9
3	7400	14	7
4	74158	16	8,15
5	74158	16	8,15
6	7475	5	12
7	7475	5	12
8	7402	14	7
9	7438	14	7
10	7438	14	7
11	7404	14	7
12	7474	14	7

Table 1. The battery and ground requirements of the ICs used in the interface circuit.

using the 8080 status information when it became available.

When the 8080 reads from core, the interface allows the core to rewrite the data that has just been read. The 8080 writes to core by ignoring the core output data and rewriting instead the data to be written. During a non-core I/O input instruction, the core goes through a read cycle with its data isolated from the 8080 data bus by interface output buffers. During a non-core I/O output instruction, the core again goes through a read cycle, ignoring the data on the 8080 bus. This technique allows the core to operate with the 8080 using a 2 MHz clock, *with no wait states!*

The interface also provides the ability to single-step a program from the front panel, if you have one, and to begin program execution at a specific address using the EXAMINE and RUN switches. The power used by the interface and by the core unit (+5 V, +12 V and −12 V) is derived from the S-100 bus and is regulated on the interface board using a simple power supply.

Construction

The S-100 interface consists of the circuitry of Figs. 2 and 3, the wiring of Figs. 4 and 5 and the power supply of Fig. 6. My prototype is on a Vector 8800V board. This S-100 board comes with a heat sink and an area on the card for a 340-T5 or 7805 type voltage regulator, which is used to power the ICs on the card.

Start by mounting the regulator and the IC sockets. Then wire the +5 volt and ground distribution shown in Table 1 (+5 volts and ground are bused on the 8800V board). Use bypass capacitors, particularly around IC9 and IC10. When this wiring is done, perform the inter-IC wiring, including the resistors and capacitors for IC1 and IC2. I soldered these parts right to the socket pins after the wiring was completed.

Next, wire the connections from the prototype board to the core assembly edge connectors, as shown in Figs. 4 and 5. The address lead wiring of Fig.

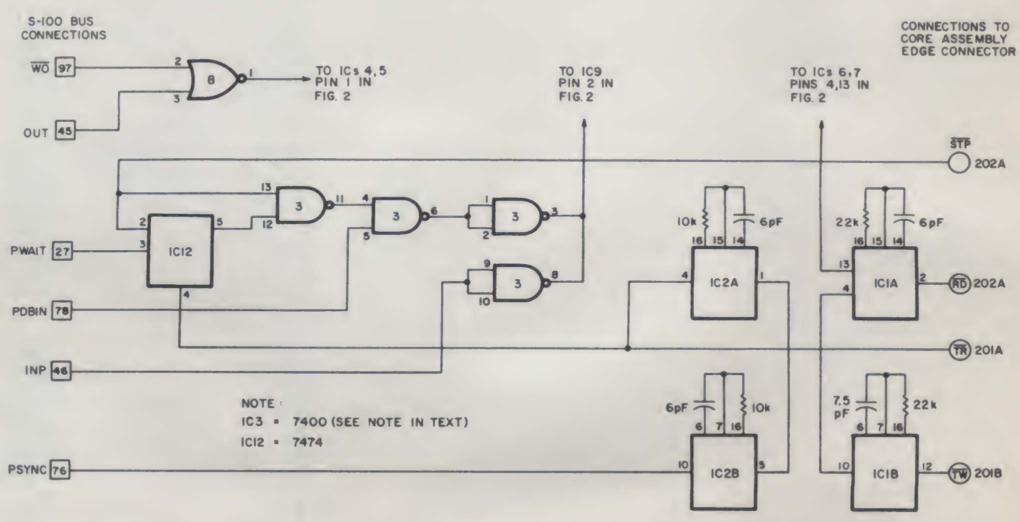


Fig. 3. The control portion of the interface. It is not advisable to "or-tie" the outputs of the TTL logic as I have done with pins 3 and 8 of IC3. If this bothers you, then use a 7403 in place of the 7400. If you do, you will have to connect each output pin to +5 V with a 470 Ohm resistor.

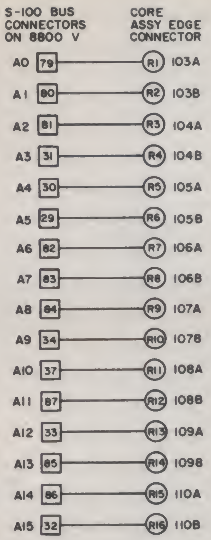


Fig. 4. The address connections between the 8800V S-100 bus and the core assembly edge connector. The numbers on the right—103A, 103B, etc. —are shown graphically in Fig. 5. Do not mix the address and data leads going to the core assembly.

4 goes directly from the edge connector lands on the 8800V to the edge connector of the core assembly. When doing this part, use no more than two feet of ribbon cable and keep the address leads, A0 to A15, and the data leads, E1-E8 and M1-M8, separate from each other. In other words, don't alternate the address leads with the data leads.

Finally, construct the power supply of Fig. 6. I assembled my unit on a single, large heat sink, using the pins of the power transistors and a couple of mini-terminal strips as tie points. Be sure to insulate the transistors and the negative voltage regulator. The tab on a negative voltage regulator is not ground. I recommend testing your completed power supply with a dummy load before connecting it to your nearly $1000 worth of core stack!

Again, pay attention to the cabling between the prototype board and the core assembly. The only difficulty I encountered in getting my unit to function was caused because I had alternated each M (write) data lead with an E (read) data lead, and simply separating the address leads, M leads and E leads from each other eliminated the problem.

Application

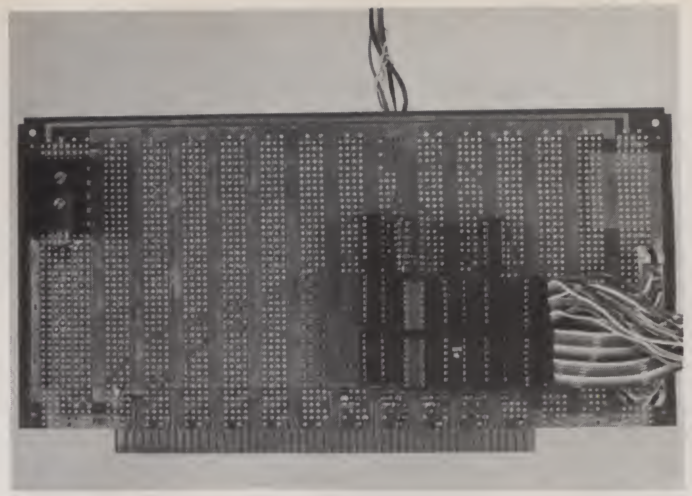
Time for the moment of truth. I plugged the interface board into my Imsai, connected the two edge connectors to the core assembly and turned on the power. The absence of great quantities of smoke was a good sign.

I had addressed the core from 0000 to 3FFFH, and preliminary tests consisted of reading and writing to the core using a monitor located in high memory RAM. Everything looked good here, so I loaded BASIC and ran a few programs. So far, the core system was working just like the 2102-type RAM boards that I had been using all along.

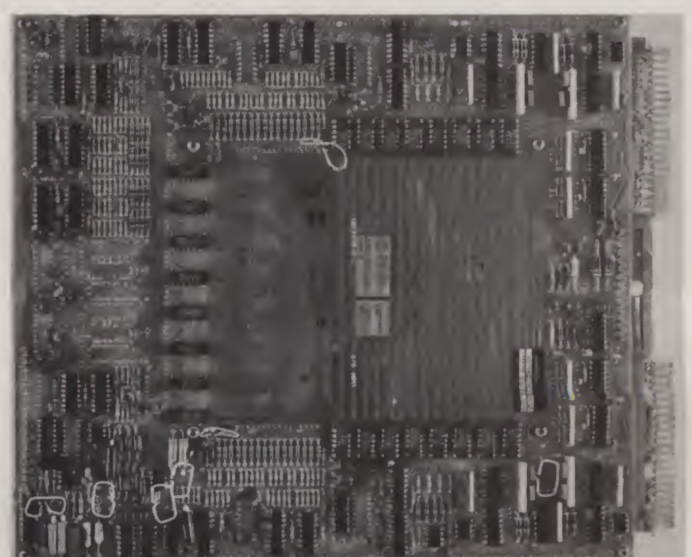
Of course, the big test was to turn off the power and see if the data would be retained. I hit the front panel STOP switch and shut off the power. After a minute I turned it back on again. Even though BASIC was still there, it refused to run. I later determined that this happened because when the Imsai 8080A was powered up, its stack pointer was set to 0000. Since my BASIC needs a usable stack area upon restart (normally provided by the monitor when it loads BASIC), it attempts to use FFFFH (0000 minus 1) as the start of its stack.

The solution to this problem was to install the smallest possible block of RAM ending at FFFFH (in my case a 4K board) to tide BASIC over until it initialized the stack pointer for itself. I was able to shut the machine off, turn it on days later and find that BASIC was still all there (along with the user program, provided that I had originally initialized BASIC for 16K), intact and ready to run.

As indicated, I hit STOP before powering down to place the CPU in a wait state, so the CPU would not initiate a memory cycle when power might not



Prototype interface card. Not realizing that the memory would draw only minimal power, I mounted the prototype power supply on a separate heat-sink assembly. It could have easily been mounted on the Vector interface card.



Ampex 8K memory card. The 8K board is hard to distinguish from the 16K version, which is the same size but contains several additional core driver chips. (Photos courtesy of Electravalue Industrial, Morris Plains NJ)

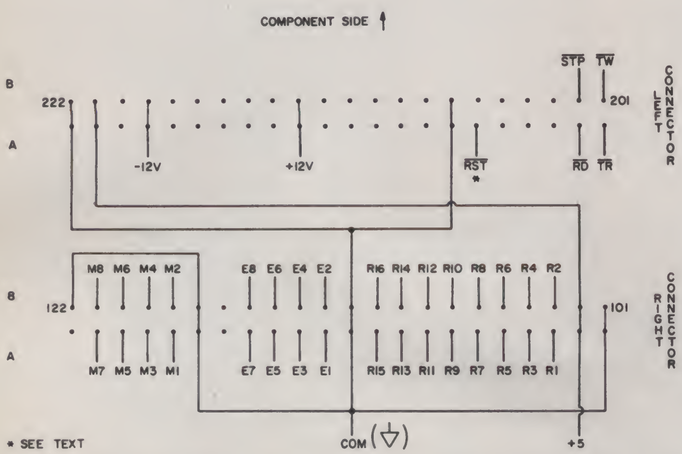


Fig. 5. A pin-out drawing of the core assembly edge connectors, looking at the edge of the board with the component side up.

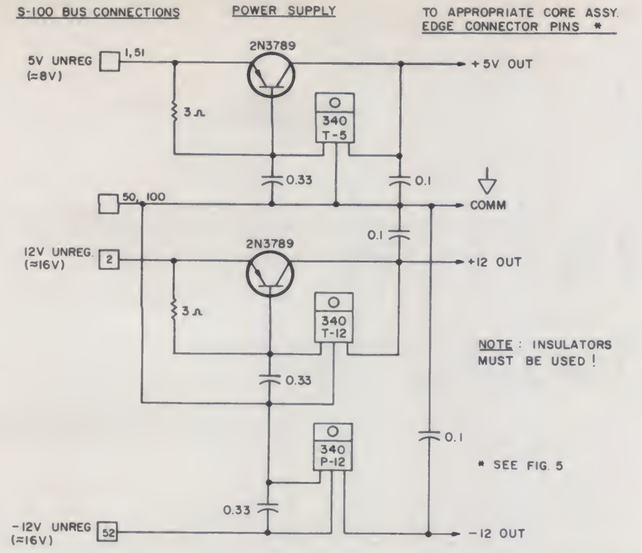


Fig. 6. The schematic diagram of the core assembly power supply. In addition to this, another 340T-5 or 7805 is mounted on the prototype board to power the interface ICs.

be available to the core system to successfully complete the cycle; this would result in lost bits. If you don't have a front panel, you can take the $\overline{RST}$ lead shown in Fig. 4 to ground before interrupting power. Grounding this lead causes the core system to inhibit further operation after the completion of the current cycle if one is in progress at the time.

It should be emphasized that when $\overline{RST}$ goes low, the core completes the current cycle and then ceases operations. The CPU, however, continues to operate, fetching and executing NOPs (00—no operation instructions). Therefore, once the $\overline{RST}$ lead is brought low, don't try to take it high again without starting the CPU from a known point in the program.

The $\overline{RST}$ input can be controlled in several different ways, either manually or automatically. An example of automatic control is a circuit that generates an interrupt in response to the loss of input ac power. A subroutine would save the 8080 internal registers in designated locations in core memory and output a low to the $\overline{RST}$ lead. These registers would be restored upon power-up, allowing the program to continue execution at the point where power was lost. This sequence would be especially effective for unattended control operations.

Fig. 7 shows the timing relationship between some of the S-100 and core control leads. This might be useful if any troubleshooting were necessary.

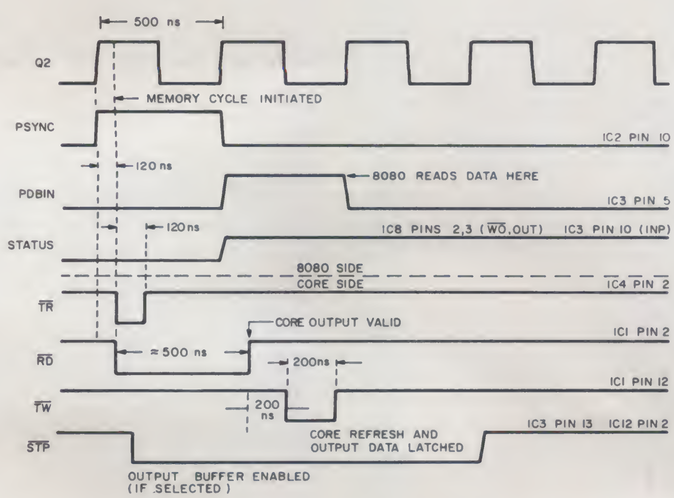
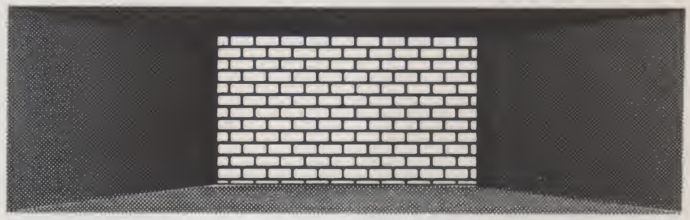


Fig. 7. A timing diagram showing the relationship between some of the S-100 and some of the core assembly control leads.

Conclusion

After loading and playing with my assembler for a while, I performed some experiments and found that the 16K of core only consumed about 12 Watts (+5 V, 1.2 A; +12 V, .5 A; and −12 V, .08 A). This is a surprisingly low figure, much lower than the specs had indicated. The core system has also proven to be tolerant of supply-voltage variations and should run comfortably within the tolerances of the voltage regulators recommended for the power supply. While I mounted the three regulators and two transistors on a separate heat sink, the whole works could have been *placed* on the Vector prototype board.

I've been using the Ampex core for several months, as the lower 16K of a 32K system, to store either BASIC or an assembler. I have to reload only when I go from BASIC to the assembler or vice versa, or when one of my assembly-language programs bombs out and eats up everything in memory. My cassette recorder, which used to get quite a workout, is getting a well-deserved rest. If your application requires both speed and nonvolatile memory, these Ampex core memory systems are definitely worth considering. ■



The MM57109 Number Cruncher

National Semi's MM57109 chip revisited, with specific hardware and software requirements.

Larry Bregoli
106 South Longyard Road
Southwick MA 01077

After a year of scratch-building my 1802-based system, I had a tape I/O, a video display circuit (taken from a super article in *73 Magazine* by Don Alexander), an ASCII keyboard and 5K of RAM. My software consisted of display programs and a monitor program of my own design (1802 software is difficult to come by), and I was ready for a math package.

Several weeks of programming later, I had a 32-bit package, with which I could add, subtract, multiply and divide, and which took up over 1K of memory. At that rate I would be older and grayer before I could take the log of a number . . . there had to be a better way.

National Semiconductor had the answer: the MM57109 Number Cruncher. The MM57109 is a number-oriented microprocessor and, with the proper interfacing, can be used as a versatile peripheral to another microprocessor system. The instruction-set description of the MM57109 has been discussed previously in an article by Dr. Adam Osborne in the May 1978 *Kilobaud* ("Number Crunching: Two Hardware Solutions," p. 84) and will not be repeated here. This article will discuss the hardware interfacing of the MM57109 with a microprocessor and the necessary software to obtain an operating system.

Table 1 is a listing of the MM57109's instruction mnemonics and an op code listing in octal and hexadecimal. This will be needed for software development later in this article, but a review of the listing should give you an idea of the power and possibilities of using the MM57109.

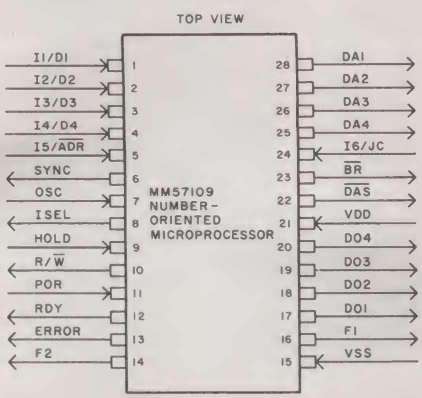


Fig. 1. Pin-out diagram of the MM57109.

With the circuitry and software described in this article, full eight-digit floating-point and scientific notation capability to $10^{\pm 99}$ is attainable. Trigonometric, inverse trigonometric functions and exponential functions are available, along with a four-function memory. ROLL and POP instructions are made available to manipulate a four-register stack if needed, along with a PI command and literal number usage.

Sound like a hand-calculator advertisement? If it does, it's probably because the MM57109 will allow you to use your micro as a super programmable calculator. If that doesn't turn you on, think about programming with FORTRAN-type statements such as

[X•(A••B – Y••2)/(P••2 + Y••2)]

or

[sin(sqrt(A + B••0.3))]

all in less than 1K of memory.

The Hardware

Fig. 1 shows the pin-out diagram for the chip. A brief description of the pin functions gives a feeling for the device's operation. Pins 1 through 5 and 24 are instruction input lines and accept instructions from the data input lines. The output ISEL line indicates whether the input is an instruction (ISEL = 1) or data (ISEL = 0). ISEL also goes low for most two-word instructions during the second word and for input and output instructions; this will be discussed later.

Pin 7 is the oscillator input line and should be operated between 320 and 400 kHz. Pin 6 is a sync output and goes low once every four oscillator cycles. Pins 9, 10 and 12 are designated HOLD, R/$\overline{W}$ and RDY, respectively, and are the handshaking signals used to interface with a microprocessor. Pins 22 and 23, labeled $\overline{DAS}$ (digit address strobe) and $\overline{BR}$ (branch), respectively, are also handshaking signals and will be discussed later.

Pins 14 and 16, labeled F2 and F1, respectively, are instruction-settable flags. Pins 17 through 20 are data output lines and are used to output the BCD data. Pins 25 through 28 are digit address lines that output sequential addresses for each BCD number output (these lines are not used in the present application).

Pin 13 is an ERROR line and goes high if a mathematical error is committed. Pin 11 is used for power on reset (POR). Pins 15 and 21 are V_{ss} (+5 V) and V_{dd} (–4 V), respectively. The chip can run with V_{ss} at 9 V and V_{dd} at zero volts, but for use with most systems using micros, V_{ss} can be operated at +5 V and V_{dd} at –4 V.

All pins are, then, 5 V-compatible with the exception of POR and HOLD, which will be discussed later in the "Circuit" section. Notice I didn't say TTL-compatible, since some outputs of the *MM57109* do not have enough drive capability to drive TTL directly. This was not

Mnemonic	Octal Op Code	Hexadecimal Op Code
0	00	00
1	01	01
2	02	02
3	03	03
4	04	04
5	05	05
6	06	06
7	07	07
8	10	08
9	11	09
DP	12	0A
EE	13	0B
CS	14	0C
PI	15	0D
EN	41	21
NOP	77	3F
HALT	17	0F
ROLL	43	23
POP	56	2E
XEY	60	30
XEM	33	1B
MS	34	1C
MR	35	1D
LSH	36	1E
RSH	37	1F
+	71	39
−	72	3A
X	73	3B
/	74	3C
YX	70	38
INV + *	40,71	20,39
INV − *	40,72	20,3A
INV X*	40,73	20,3B
INV /*	40,74	20,3C
1/X	67	37
SQRT	64	34
SQ	63	33
10X	62	32
EX	61	31
LN	65	35
LOG	66	36
SIN	44	24
COS	45	25
TAN	46	26
INV SIN*	40,44	20,24
INV COS*	40,45	20,25
INV TAN*	40,46	20,26
DTR	55	2D
RTD	54	2C
MCLR	57	2F
ECLR	53	2B
JMP*	25	15
TJC	20	10
TERR*	24	14
TX = 0*	21	11
TXF*	23	13
TXLTO*	22	12
IBNZ	31	19
DBNZ	32	1A
IN*	27	17
OUT*	26	16
AIN	16	10
SF1	47	27
PF1	50	28
SF2	51	29
PF2	52	2A
PRW1	75	3D
PRW2	76	3E
TOGM	42	22
SMDC*	30	18
INV	40	20

*indicates a two-word instruction

Table 1. MM57109 mnemonic and operation codes.

a problem for the present application since CMOS logic is used, and all outputs of the MM57109 are capable of driving CMOS.

Fig. 2 is a block diagram for interfacing the MM57109 with a microprocessor system. As in most peripheral interfacing, an instruction or data word is placed on the bus, and an I/O device select signal is generated by the microprocessor.

In this case the device select signal latches the byte from the bus into the input latches; at this time the RDY line is high, telling the microprocessor that the number processor is ready for an input. The device select signal also puts the HOLD line low, telling the number processor to perform the instruction. RDY is then set low by the number processor telling the rest of the world that an instruction is being performed.

When the MM57109 is through with the operation, the RDY status line goes high, again resetting the HOLD line to its high state through the handshaking circuits. The high status of the RDY line tells the host microprocessor that the MM57109 is ready for the next instruction. If the instruction is an OUT, the answer is sent out one digit at a time with an R/$\overline{W}$ pulse for each digit. The R/$\overline{W}$ pulse latches the BCD digit into the output latch.

A digit address status signal, $\overline{DAS}$, occurs before and after each digit sent out and can be used to store the present digit into RAM. When all digits have been sent out and stored in RAM, the RDY signal goes high as in other instructions, telling the microprocessor the output is over.

Fig. 3a shows the circuitry to interface the MM57109 with an 1802 microprocessor. The TPB and N0 lines should be the only lines unfamiliar to users of micros other than the 1802. N0 is simply an 1802 designation for one of three I/O select lines set high for one machine cycle when selected. TPB is a clock pulse that goes high once each machine cycle at a time when the data on the bus is valid.

The Circuit

Now that we're all on common ground, let's go through the circuit, starting with a call from the host microprocessor for an operation by the MM57109. When this happens the host micro sends out a memory read ($\overline{MRD}$) signal and a simultaneous I/O signal (N0) to transfer a memory byte from memory to the system bus.

The combination of these

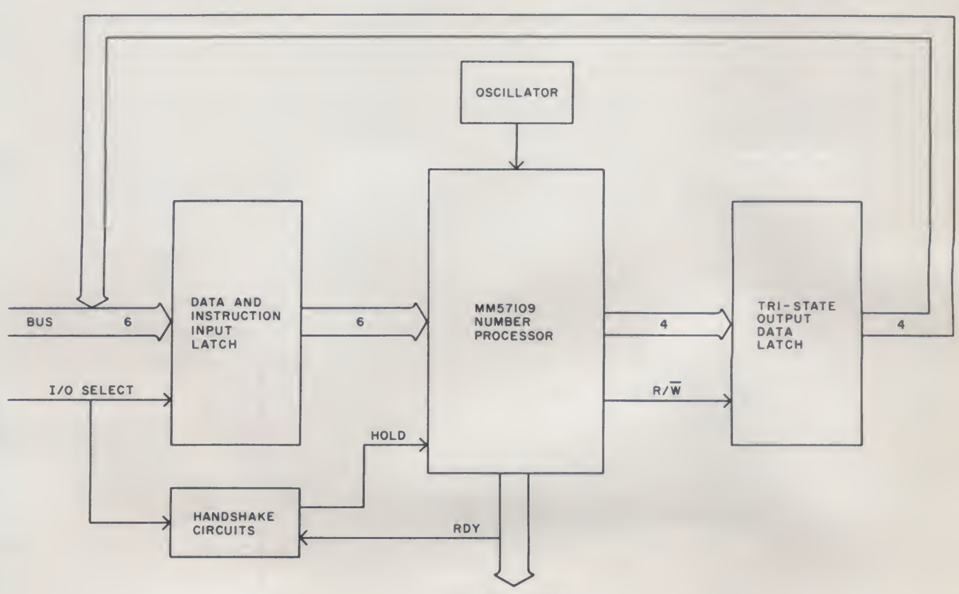


Fig. 2. Block diagram of number processor interfacing.

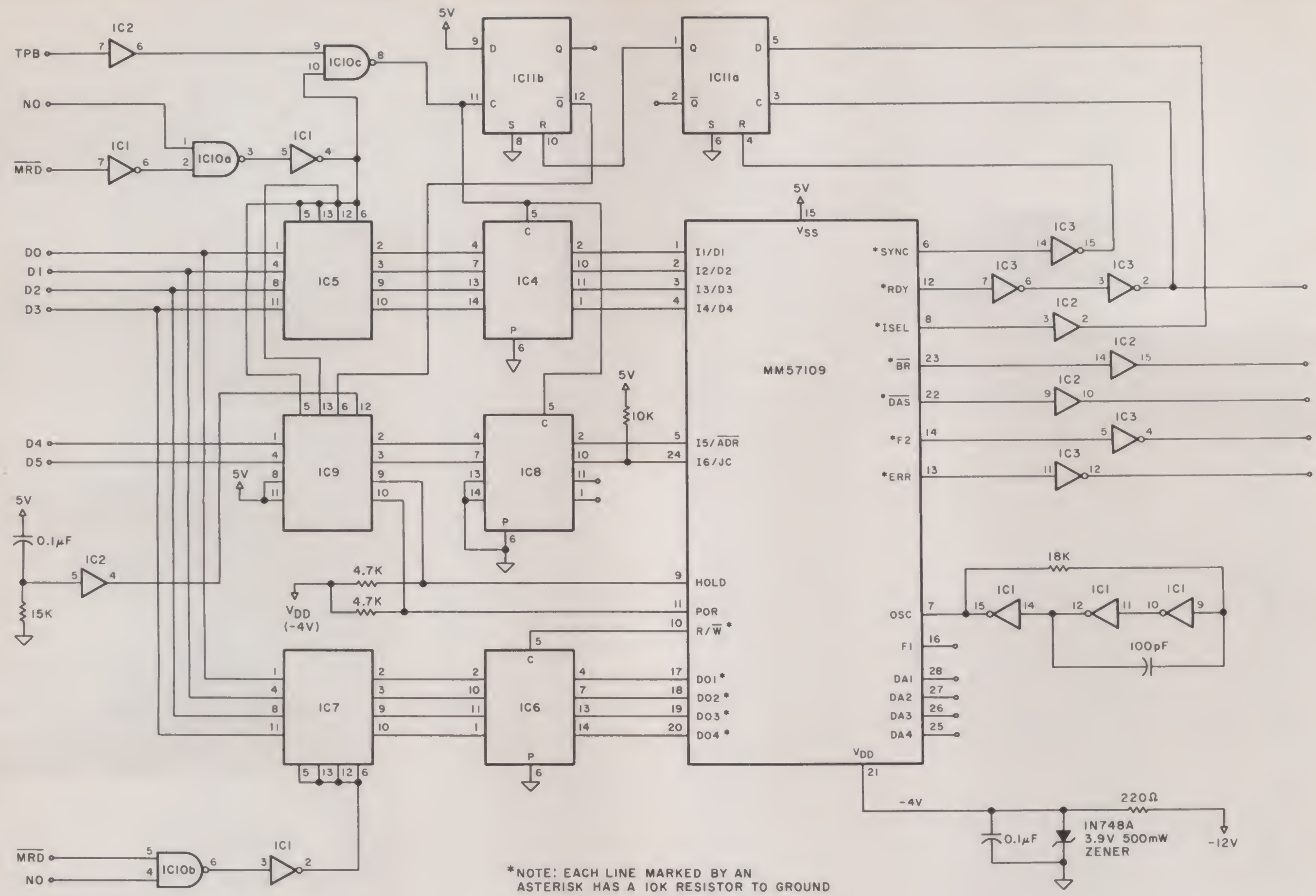


Fig. 3a. MM57109 interfacing circuitry.

two signals and the logic performed by the NAND gate IC10A causes a high level to appear at pin 4 of inverter IC1. This closes six of the eight 4016 switches in ICs 5 and 9, placing the bus byte at the inputs of the 4042 input latches IC4 and 8. The latching strobe (TPB) occurs when the bus byte is valid and, through the logic performed by NAND gate IC10C, latches the data into the input latches.

Notice that at this time IC10B and its inverter are applying the opposite logic level to the four output Tri-state switches in IC7, maintaining these switches in their Tri-state mode.

With the bus byte safely latched up in the input latches, let's digress a little and look at the operation of pins 9 and 11 of the MM57109. These lines are the HOLD and power on reset (POR) lines I promised I would discuss. Both of these lines must operate with a low logic level of −4 V when V_{ss} is 5 V. This is accomplished by using two of the Tri-state switches in IC9. One side of each of these switches is connected to V_{ss}, and the other side is connected through a 4.7k resistor to V_{dd}.

When a high logic level is applied to the control line of one of these Tri-state switches, the switch closes and 5 V is applied to the selected line of the MM57109. When a low logic level is applied to the switch control line a −4 V is applied to the MM57109 through one of the 4.7k resistors. The POR line, therefore, goes to 5 V at start-up and, after a time period determined by the 15k resistor and 0.1 uF capacitor at pin 5 of IC2, goes to −4 V. The minimum time at 5 V set by the RC circuit should not be less than eight oscillator clock periods.

The bus byte, as you'll remember, was just latched up in the input latches by a strobe signal at pin 8 of NAND gate IC10C. This signal also clocks the D flip-flop IC11B, causing $\overline{Q}$ to go low bringing the HOLD line to its −4 V low level. Recall from the block diagram discussion that this causes the number processor to start its operation, and RDY goes low.

At the end of the instruction or data-entry operation, the MM57109 puts RDY high again to indicate end of operation. This clocks IC11A, which, in turn, resets IC11B, causing the HOLD line to return to its high state. The SYNC output of the MM57109 resets IC11A.

You're probably wondering why the D input of IC11A is connected to ISEL. The reason is that there is more than one RDY pulse for all two-word instructions and for the input and output instructions in the MM57109 instruction set.

In order to use these instructions, the first RDY pulse must be ignored or HOLD will go high in the middle of a two-word instruction. Fortunately, the ISEL line is low during the first RDY pulse of a two-word instruction and goes back high just before the second RDY pulse arrives. When the ISEL line is low, IC11A will not change state when the intermediate RDY pulse arrives.

To get data back from the number processor, an OUT instruction code is passed to the MM57109, which, in turn, starts to output BCD data to the 4042 output latch IC6. Each BCD dig-

IC Number	IC Type	5 V Pin	Gnd Pin
5,7,9	4016	14	7
4,6,8	4042	16	8
11	4013	14	7
10	74C00	14	7
2	4050	1	8
1,3	4049	1	8

Fig. 3b. Power and ground connections for ICs in Fig. 3a.

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it is latched into the output latch with the R/$\overline{W}$ line. At the end of each digit there is a $\overline{DAS}$ pulse, which is used by the software to clock the latched BCD digit into memory. IC10B provides the logic to put the latched digit onto the bus while the host micro is supplying a memory write ($\overline{MWR}$) pulse to the appropriate memory chips to write the data into memory.

The status lines RDY, $\overline{BR}$, $\overline{DAS}$ and FLAG-2 in my system are connected to flag inputs on the 1802 and are used to communicate information that is needed by the software, which will be discussed in a separate section. The ERROR status line can be connected to a front panel LED to indicate any math errors committed. FLAG-1 is not used in my system but can be used if needed as a software-settable output.

When interfacing CMOS logic with the MM57109, you need a 10k pull-down resistor at each output line of the MM57109. The lines of the MM57109 that need a resistor are labeled in Fig. 3a by an asterisk. These resistors were not drawn in for the sake of clarity in the figure.

A 10k pull-up resistor is also needed on pin 24 as specified by the National Semiconductor instruction sheets. The clock circuit was also recommended in the instruction sheets and operates at approximately 400 kHz. I recommend that you obtain and read the MM57109 instruction sheets, which can be obtained from Tri-Tek, Inc. There is much valuable information presented in the text, including the instruction set.

A word about the instruction set in Table 1: The op code that was given in octal representation in the National Semiconductor literature has been converted to a hexadecimal listing for the convenience of those using hex-oriented micros.

The construction is not difficult to do. I used wire-wrap techniques and IC sockets throughout and put the whole circuit on a 4 inch x 4.5 inch Radio Shack PC board with a 22-pin edge connector. Discrete components were soldered to Vector T49 wire-wrap terminals and wire-wrapped into the circuit.

Remember that the ICs are CMOS devices, and, although most of these devices are input-protected nowadays, a static shock can still blow one out. Be sure to ground any unused inputs on the CMOS chips. Any floating inputs may cause excess heating of the chip. Before plugging in the MM57109, check the power supply voltages for proper values. An error here can be expensive. If the power supply voltages look OK, shut off the power and plug in the chips.

The system may be tested by temporarily connecting an LED to the FLAG-2 line as shown in Fig. 4 or by monitoring the line with a voltmeter after the set-flag-2 (SF2) instruction is executed. The software routine for execution of the SF2 test instruction is given in Fig. 5.

If the LED does not light, check the outputs of the instruction latches for the proper binary code. If the code is not proper, the problem could be the software or the input hardware; if the code is proper, the problem is probably the oscillator or the MM57109 wiring.

When the LED lights and you wake up your household by shouting "EUREKA," it's time to start on the software math package.

The Software

The software that follows will require three temporary stacks. One stack, which I call a SEQUENCE or just S stack, is where the program to be run by the MM57109 is assembled. The second temporary stack is called the PRECEDENCE or P stack and is used to set the mathematical precedence of the operators (**,*,/,+,(,)) in your math statement. For example, if your math statement was

[A•B+A•(B•D+C••E)]

then the computer must know that all operations within the parentheses must be completed first and, within any given parentheses, what operators have precedence.

The above math statement is written in what is called Infix Notation, that is, the operators are between the operands or numbers to be operated on. The MM57109, however, can only solve problems presented to it in Reverse Polish Notation or RPN. A conversion from Infix to Reverse Polish Notation must therefore be performed. This is not unusual; most large computers work in Polish Notation at the machine level since it is very efficient from a computer's standpoint. The above math statement in RPN, however, would look like

[AB•ABD•CE••+••+]

which is fine if you're a computer . . . I'd rather let my micro convert for me.

The P and S stacks are of variable length depending on the length and complexity of your math statement. A third, temporary, but fixed-size, stack is used to store the answer from the MM57109 while it is being converted to a format for display. I call this the answer or A stack, which is only 12 bytes long.

The on-screen format that I use for the math statements is to begin and end each statement with the brackets, []. This allows the computer to tell where things begin and end while it is scanning a statement. I also use spaces between operators and numbers to distinguish between them. Parentheses are used to tell which section of the problem to do first. For operators such as the trig and exponential functions, I use parentheses to contain the argument, for example, sin (A+B).

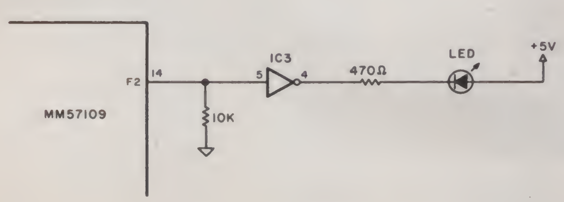

Fig. 4. F2 test circuit.

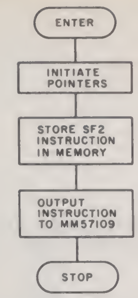

Fig. 5. Set F2 test program.

The method I use to recognize operators, such as sin, log, ROLL or POP, for example, is to sum up the hex values of the ASCII letters as the computer scans the statement until a space or (is encountered. The resulting number is then found in a lookup table, and the corresponding MM57109 instruction code is obtained.

Some trial and error was used to obtain a unique value for the hex sum of each mnemonic chosen. Table 2 is the lookup table used in my system but is definitely not the only one that could be used; it is offered only as a guide.

You'll notice if you look back at Table 1 that there are seven inverse statements such as the inverse trig functions available. I handle these by preceding the operator with an "I," for example, Isin(A+B). When the computer finds an "I" in the math statement, it immediately sets a flag to indicate an inverse function, then continues to sum the rest of the ASCII values in the operator (not including the "I").

The use of letters to represent fixed numbers is handled by designating an area on the display to write the values of these numbers along with their literal values. I use the top three lines of my display to do this.

In the math statement I use an apostrophe before each literal number so the computer will recognize this letter as a literal number. For example, when the computer is scanning a math statement and 'Y is encountered, it immediately starts scanning the top three lines of the display for Y. When it finds

Mnemonic	Hex Sum	Hex Op Code	Mnemonic	Hex Sum	Hex Op Code
+	2B	39	XI	A1	37
−	2D	3A	TENX	3F	32
*	2A	3B	ROLL	39	23
/	2F	3C	POP	EF	2E
**	54	38	LSH	E7	1E
ln	DA	35	RSH	ED	1F
exp	4D	31	RAD	D7	2D
log	42	36	DEG	D0	2C
sin	4A	24	MCLR	2E	2F
cos	45	25	MS	A0	1C
tan	43	26	MR	9F	1D
sqrt	CA	34	XEM	EA	1B
sq	E4	33	XEY	F6	30
EE	8A	0B	SF2	CB	29
SMDC	27	18	PF2	C8	2A
TOGM	37	22	dM	B1	1A
ECLR	26	2B	iM	B6	19

Table 2. Operator lookup table.

the Y, it takes the number following and puts it in the S stack as it would if the number were originally contained in the math statement. The computer then returns to the math statement to continue the scan.

If a lowercase p is found in the scan, the computer recognizes it as pi and puts ODH into the S stack, preceded by a NOP instruction, 3FH. The need for the NOP instruction will be discussed later.

The last formatting item is the display of the answer. After the right-hand bracket,], at the end of a math statement, I type in an equal sign. This starts the scan of the math statement by backing up until the left-hand bracket, [, is found. The direction of the scan is then reversed, and the statement is scanned from left to right.

When the end bracket,], is encountered, an OUT instruction is put in the S stack, and the assembled math statement in the S stack is fed to the MM57109 one instruction at a time. When the OUT instruction is completed the answer will be contained in the A stack. The A stack is then converted to an ASCII number and placed on the display following the equal sign.

Each time an operand is put on the S stack it is preceded by a NOP instruction as mentioned above for the pi operand. The purpose of the NOP instruction is to avoid the possibility of two operands being placed on the S stack, one following the other, and the MM57109 misinterpreting them as a single number. The NOP instruction does nothing but end number entry.

Fig. 6 shows an overall flowchart for the MM57109 math package. A few blocks in Fig. 6 should be looked at in more detail since they involve some MM57109 instructions not discussed previously. One of those is the Operand subroutine, which allows for the use of negative numbers, decimal points and power-of-ten notation. Fig. 7 shows the flowchart for this subroutine.

Suppose a number in the math statement is −12.34E−56. The computer will pick up the first term and set the minus flag. The next two terms will have the leading 3s stripped off and be put into the S stack as 01 and 02. When the decimal point is encountered, 0A will be placed on the S stack. The next two numbers will be entered on the S stack as 03 and 04—up to eight digits may be used in the mantissa.

When the E is picked up, a

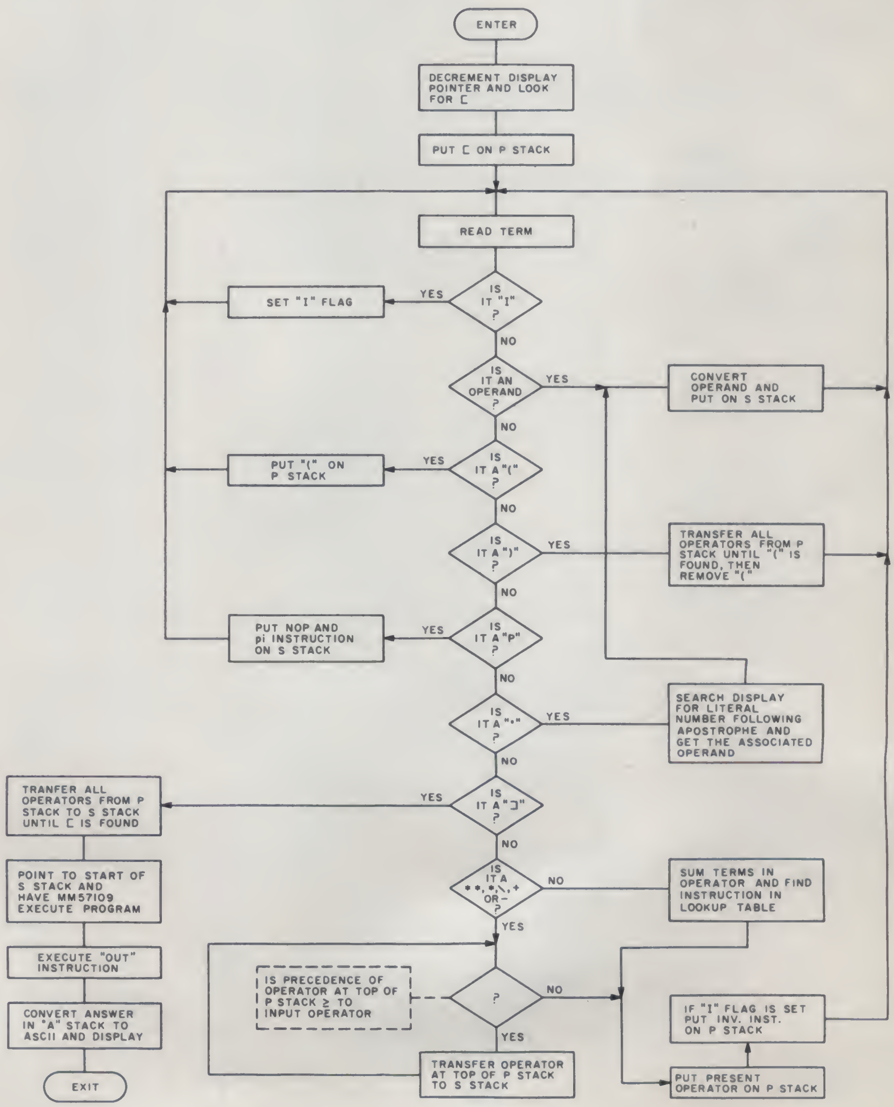

Fig. 6. Flowchart of MM57109 math software.

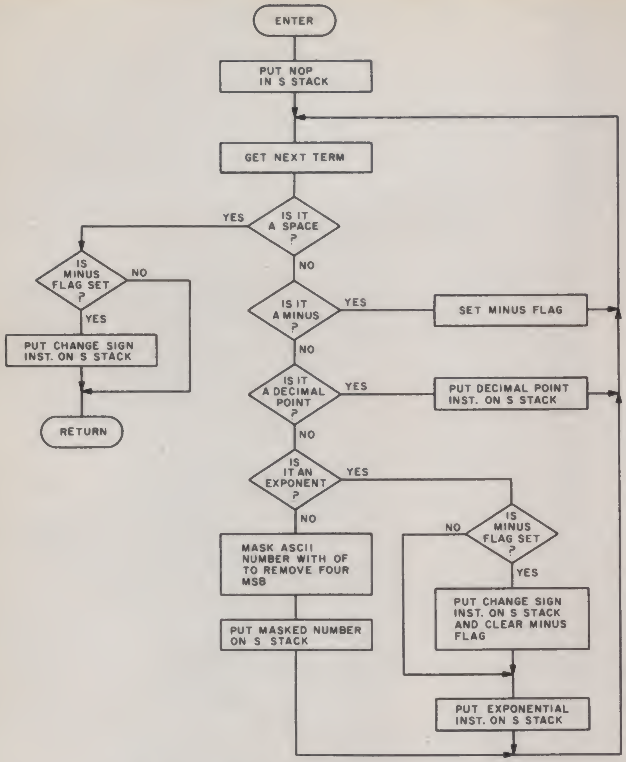

Fig. 7. Flowchart for OPERAND subroutine.

The software then allows the first $\overline{DAS}$ logic low pulse to pass by, then waits for the next $\overline{DAS}$ pulse before putting any data in memory. When this pulse arrives, the first digit in the answer is stored in the A stack. The routine then waits for the $\overline{DAS}$ pulse to go high again before proceeding.

The program then starts to test for a low on the $\overline{DAS}$ line or a high on the RDY line. If a $\overline{DAS}$ pulse is encountered, another digit is placed in the A stack. This continues until a high RDY that causes an exit from the program is encountered, since at this time all digits have been sent out.

Two output data formats are used by the MM57109. The chip starts up in the floating-point mode and may be switched to scientific notation by execution of a TOGM instruction. The number of digits in the mantissa may also be selected by execution of an SMDC instruction, along with a BCD number, indicating the number of digits. If an SMDC instruction is not performed, the mantissa will contain eight digits.

If the output data format is left in floating point, then the first digit sent out will be a sign digit. For a positive number this digit will be zero, and for a negative number it will be a binary 8. (Note that since the four most significant bits of the system bus are not used during the data output mode of the MM57109, they will go to their unprogrammed logic level. In my system they are all ones causing each output number to have an F preceding it. For example, the binary 8 above would be F8 in the answer stack.)

The second digit out contains a binary number indicating the digit number after which the decimal point should be placed. For some reason which I have yet to discover, the binary number with decimal

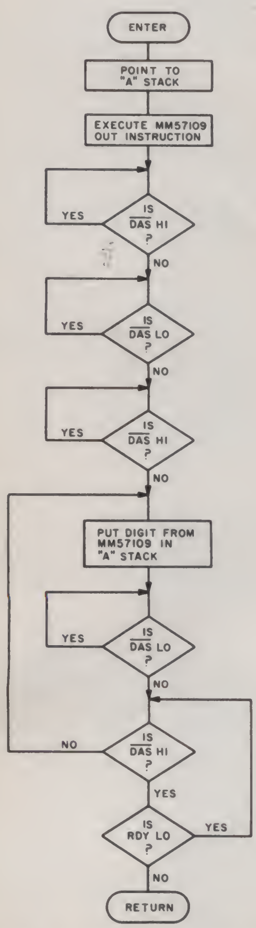

Fig. 8. Flowchart for OUT subroutine.

test is made to see if the mantissa minus flag was set. If it was, 0C (change sign instruction) is then sent to the S stack—followed by the numbers 04 and 05. The minus flag would have been set again for the negative power of ten, and a second change sign instruction would be placed at the end of the converted operand. The number in the sequence stack would then look like

3F,01,02,0A,03,04,0C,0B,05,06,0C.

The OUT subroutine contains the software to accept the BCD digits contained in the answer as the MM57109 puts them out. The $\overline{DAS}$ and RDY status lines are monitored by this program to keep the output timing correct. When the MM57109 receives an OUT instruction, the RDY line goes low until all digits have been sent out. The $\overline{DAS}$ line sends a logic low pulse out after each digit and one pulse prior to the first digit.

Fig. 8 shows the flowchart for the OUT subroutine. Upon entering the routine a space in memory called the A stack, which will store the answer, is pointed to. The OUT instruction is then sent to the MM57109.

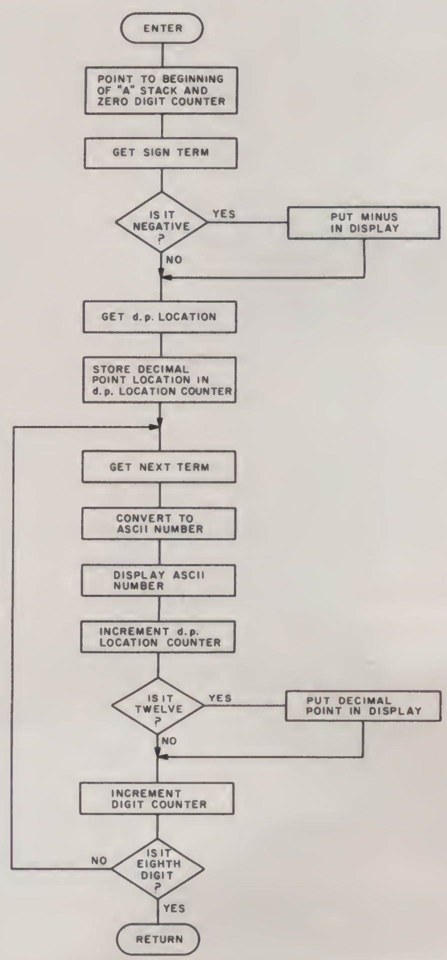

Fig. 9. Flowchart to display a floating-point number.

✓ *Reader Service—see page 195*

equivalent 11 indicates the decimal point is placed to the right of the most significant digit, while a decimal value of 10 indicates the point is after the second most significant digit, etc.

The next eight digits are BCD numbers representing the numerical answer with the most significant bit first. The number −12.345, therefore, would be represented in the A stack as

F8 FA F1 F2 F3 F4 F5 F0 F0 F0

with the mantissa count set to eight. Fig. 9 is a flowchart for converting the A stack into a floating-point display.

The output format for a number in scientific notation is somewhat different. The first two digits in this case are the most significant exponent digit and the least significant exponent digit. The third digit is a sign digit which contains the sign of the mantissa and exponent. This digit is zero if both mantissa and exponent are positive; it is a one if the exponent is negative and the mantissa, positive; it is a nine if both are negative; and it is an eight if only the mantissa is negative. The fourth output digit is not used. The next eight digits contain the mantissa with the decimal point location always after the most significant digit. The number −1.2345000E01 would look like

F0 F1 F8 XX F1 F2 F3 F4 F5 F0 F0 F0

in the A stack.

The flowchart shown in Fig. 11 describes the subroutine that determines the precedence of the operators in the math statement. There is nothing in it unique to the MM57109 architecture, and it is included only as a guide to help you complete your software package.

I will recommend again that you get the National Semiconductor literature on the MM57109 to assist you in both the hardware and software aspects of this project. Another valuable reference source from which several concepts for this article were obtained is a book called *Digital Networks and Computer Systems* by Taylor L. Booth, published by John Wiley and Sons, Inc.

When you've completed your software, which should take about three pages of memory, you will have added a capable math package for performing computations with your micro.

The branch instructions available with the MM57109 are not put to use with this simple software package. They are, however, versatile instructions, and I have put them to use in a small software assembler program, using many of the same subroutines discussed in this article. If you intend to do this also, you can use the $\overline{BR}$ status line to indicate if the branch statement is true or false. Ah . . . but this is another subject.

The capabilities of the present software should provide plenty of challenge for solving the problems of the world. ■

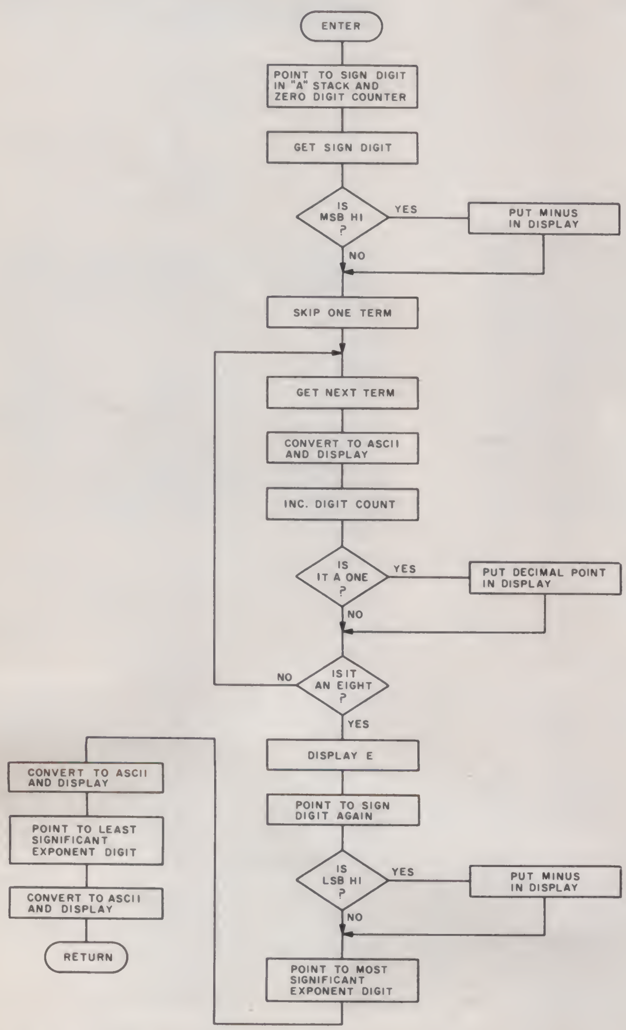

Fig. 10. Flowchart to display a number in scientific notation.

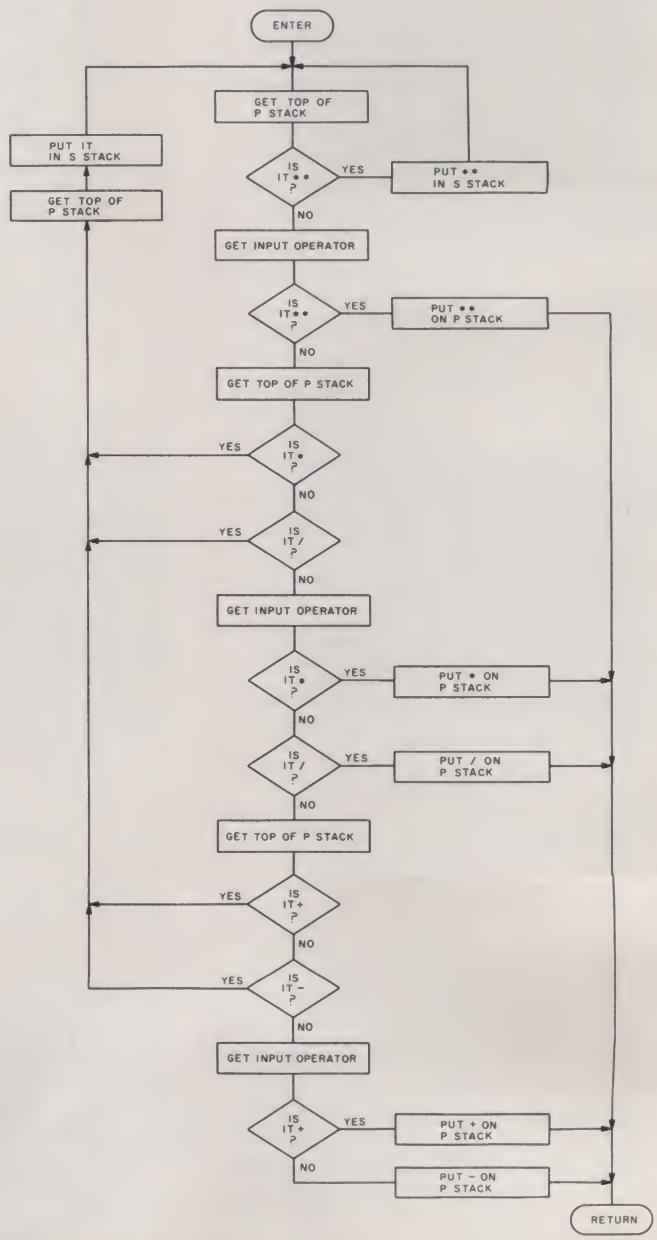

Fig. 11. Flowchart of PRECEDENCE subroutine.

With these five disks, I can turn your TRS-80 into a serious computer.

My name is Irwin Taranto, and I know what I'm talking about.

I've been making computers work ever since they had vacuum tubes in them, and I've put the first computer into more than 300 different businesses.

Over the years, I've learned a few things.

For instance, I've learned that the new microcomputers like the TRS-80 are really elegant pieces of hardware. The price is deceiving. Given the right programs, they can jump through hoops.

But finding the right programs isn't all that easy. You can flip through the pages of this magazine and find 50 ads for TRS-80 programs. Granted, a good many of them are for fun and games, but you can still find quite a few offering business programs.

They aren't like mine, though.

Four of these are the genuine Osborne & Associates systems, originally designed for the $30,000 Wang computer. I've made a few minor modifications on them, and now they work on a $4000 TRS-80. The fifth program is one I added myself.

Here's what's on each disk:

THE ON-LINE, INTERACTIVE OSBORNE PROGRAMS

Accounts Payable: an invoice-linked system that can calculate and print checks, make reports, and link fully to the general ledger.

Accounts Receivable: also invoice-linked, it can keep track of billed and unbilled invoices, open and closed items and aging. It can print a statement and link to the general ledger.

General Ledger: this handles more than 1750 transactions on 200 different accounts and keeps track of them by month, quarter, year and the previous three quarters. Available with or without Cash Journal option.

Payroll: it keeps the files, computes pay and deductions, prints forms and checks, figures taxes, overtime and piecework pay, and prints the 941-A and W-2 forms.

AND AN ON-LINE, INTERACTIVE TARANTO PROGRAM

Inventory Control: a custom-tailored program that looks after up to 20 sizes of each of 1300 items—a million items in all. It gives an immediate readout on any item inquiry, including quantity and dollar total.

These programs are marvels of efficiency. They're fully-documented, and you can buy the books locally or from me. On the Osborne programs, my contribution was simply this: I made them work on the TRS-80, and if you buy them from me, I'll make them work for you.

If you're skeptical on that point, call the number below and we'll give you the names of some of the people who've already bought all over the world. Then you can call them up and hear what they have to say.

These programs only cost $99.95 each. (The Cash Journal option on the General Ledger adds another $50.) For that you get the disk, all the instructions you need, and my telephone number. If you call, we answer all your questions and make sure everything's working smoothly. If your question's tough enough, I'll talk to you personally.

Because, as I said, I plan to turn that TRS-80 of yours into a serious computer.

Please send me the following programs at $99.95 each:

		book ☑
Accounts Payable		
Accounts Receivable		
General Ledger (add $50 for Cash Journal)		
Payroll		
Inventory Control		
Add $3 per order for handling		
6% tax (California only)		
AMOUNT ENCLOSED		

If you need the books, add $15 each.

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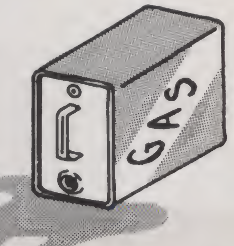

HAPPY MOTORING!

It started in California and traveled east. Gasoline has become precious. What better time for a program to keep track of fuel consumption, fuel economy and miles driven?

```
100 REM A MILEAGE CALCULATOR
110 REM BY PHIL FELDMAN AND TOM RUGG  COPYRIGHT 1978
120 MW=60:MR=75:N=0
130 DIM D$(MR),D(MR),G(MR),M(MR)
150 PRINT CHR$(147):PRINT TAB(16);CHR$(18);"MILEAGE":PRINT:PRINT"COMMANDS"
160 PRINT" 1 - READ OLD MASTER FILE FROM CASSETTE"
170 PRINT" 2 - INPUT DATA FROM TERMINAL"
180 PRINT" 3 - WRITE NEW MASTER FILE TO CASSETTE"
190 PRINT" 4 - DISPLAY MILEAGE DATA":PRINT" 5 - TERMINATE PROGRAM":PRINT
200 INPUT" ENTER COMMAND BY NUMBER";R:IF R<1 OR R>5 THEN 150
210 ON R GOSUB 250,300,500,600,800:GOTO 150
250 R$="READING":GOSUB 850:OPEN 5,1,0:INPUT#5,T$:PRINT"READING FILE: ";T$
255 INPUT#5,N:IF N>MR THEN PRINT"*** TOO MANY FILES ON TAPE":END
260 FOR J=1 TO N:INPUT#5,D$(J),D(J),G(J):IF 64 AND ST THEN 900
270 NEXT:PRINT:PRINT N;" DATA RECORDS READ":CLOSE 5:GOSUB 920:RETURN
300 IF N=MR THEN 470
310 PRINT:PRINT"ENTER THE FOLLOWING DATA AS REQUESTED"
320 PRINT" - DATE (E.G. 1/30/78)"
325 PRINT" - ODOMETER READING (MILES)"
330 PRINT" - # GALLONS BOUGHT"
340 N=N+1:PRINT:INPUT"DATE";R$:R$=LEFT$(R$,8):D$(N)=R$
350 INPUT"ODOMETER";R:IF R<0 OR R>999999 THEN 350
360 GOSUB 940:D(N)=R:INPUT"# GALLONS";R:IF R<0 OR R>9999 THEN 360
370 GOSUB 940:G(N)=R:PRINT:PRINT TAB(3);"INPUT     DATE: ";D$(N)
380 PRINT TAB(3);"CHECK     ODOMETER:";D(N):PRINT TAB(13);"GALLONS:";G(N)
400 PRINT:PRINT SPC(10);" - IS INPUT OK ? -":PRINT
410 INPUT" (Y=YES, N=NO, F=YES AND FINISHED)";R$:R$=LEFT$(R$,1)
420 IF R$="N" THEN N=N-1:PRINT:PRINT" REDO LAST DATA":GOTO 340
430 IF R$="F" THEN RETURN
440 IF R$<>"Y" THEN 400
450 IF N=MR THEN 470
460 GOTO 340
470 PRINT:PRINT"*** NO MORE DATA ALLOWED":GOSUB 920:RETURN
500 IF N<1 THEN PRINT:PRINT"*** NO DATA TO WRITE":GOSUB 920:RETURN
510 R$="WRITING":GOSUB 850:PRINT:INPUT"NAME FOR FILE";T$:K=N:IF N>MW THEN K=MW
520 OPEN 5,1,1:PRINT#5,T$:PRINT#5,K:K=1:L=N
530 IF N>MW THEN K=N-MW+1:PRINT" - ONLY LAST";MW;"VALUES WILL BE WRITTEN"
540 FOR J=K TO L:PRINT#5,D$(J):PRINT#5,D(J):PRINT#5,G(J)
550 POKE 59411,53:Z=TI
560 IF TI-Z<5 THEN 560
570 POKE 59411,61:NEXT:CLOSE 5:RETURN
600 IF N<=1 THEN PRINT:PRINT"*** NOT ENOUGH DATA":GOSUB 920:RETURN
610 M(1)=0:FOR J=2 TO N:IF G(J)=0 OR G(J-1)=0 THEN M(J)=0:GOTO 640
620 R=(D(J)-D(J-1))/G(J):IF R<0 OR R>9999 THEN R=0
630 GOSUB 940:M(J)=R
640 NEXT:K=-17:L=0
650 K=K+18:L=L+18:IF L>N THEN L=N
660 PRINT CHR$(147);"  DATE    ODOMETER   GALLONS      MPG"
670 B=2:U=4:GOSUB 750:B=4:U=8:GOSUB 750:B=3:U=7:GOSUB 750:B=6:U=3:GOSUB 750
680 PRINT"":FOR J=K TO L:PRINT D$(J);:R=D(J):B=16:GOSUB 770
690 R=G(J):B=25:GOSUB 770:R=M(J):B=36:GOSUB 770:PRINT"":NEXT:PRINT
700 IF L=N THEN PRINT"HIT RETURN KEY FOR COMMAND MODE":GOSUB 960:RETURN
710 PRINT"HIT RETURN KEY TO CONTINUE":GOSUB 960:GOTO 650
750 PRINT SPC(B);:FOR J=1 TO U:PRINT CHR$(197);:NEXT:RETURN
770 Q=LEN(STR$(INT(R))):IF R>0 AND R<1 THEN Q=1
780 PRINT TAB(B-Q);R;:RETURN
800 END
850 PRINT:PRINT"1) POSITION CASSETTE TAPE FOR ";R$;"."
860 PRINT"2) PRESS THE CASSETTE STOP KEY."
870 PRINT"3) PRESS THE RETURN KEY WHEN READY.":GOSUB 960:RETURN
900 PRINT:PRINT"*** FATAL ERROR IN CASSETTE READ":STOP
920 FOR Q=1 TO 3000:NEXT:RETURN
940 R=R*10+.5:R=INT(R)/10:RETURN
960 GET R$:IF R$="" THEN 960
970 RETURN
```

Program listing.

For many of us, automobile operating efficiency is a continual concern. This program can help by keeping track of gasoline consumption, miles driven and fuel mileage for a motor vehicle. It allows reading and writing data files with the cassette unit; thus a master data file may be retained and updated. The program computes mileage (miles per gallon, or MPG) obtained after each gasoline fill-up. A running log of all information is maintained. This enables trends in vehicle operation efficiency to be easily checked.

How to Use the Program

The program requests the following data from the operator as a record of each gasoline fill-up: date, odometer reading and number of gallons purchased. The most useful results will be obtained if entries are chronological and complete, with each one representing a full gasoline fill-up.

To use the cassette features, the operator must be able to position the tape correctly for both reading and writing. The simplest way to do this is to record files only at the beginning of a tape. One tape could certainly be used this way, with each file writing over the previous one. However, we suggest alternating between two physical tapes. This will ensure a reasonably up-to-date backup tape in case of any failure.

The program operates from a central command mode. The operator requests branching to any of five available subroutines. When a subroutine completes execution, return is made to the command mode for any additional requests. A brief description of each subroutine follows.

Read old master file: This effects the reading of previously stored data from the cassette. Any data already in memory is nullified. During the read, the name of the data file and the total number of records read are displayed.

Input from terminal: This enables the entering of data records directly from the terminal. This mode is used to provide additional information after a cassette read and to enter

This is a chapter from the book 32 BASIC Programs for the PET Computer *by* Microcomputing *Associate Editors Tom Rugg and Phil Feldman. It's available at most computer stores or from dilithium Press, PO Box 92, Forest Grove OR 97116.*

120-130	Dimensioning and variable initialization.
150-210	Command mode. Displays available subroutines and branches to the operator's choice.
250-270	Reads data from the cassette unit.
300-470	Accepts terminal input.
500-570	Writes data to the cassette unit.
600-780	Calculates mileage and displays all information.
800	Terminates execution.
850-900	Displays messages for cassette operation.
920	Delay loop.
940	Rounds numbers to nearest tenth.
960-970	Tests for operator response.

Table 1. Main routines.

MW	Maximum number of data records to write.
MR	Maximum number of data records in memory.
N	Current number of data records in memory.
D$	Array of dates.
D	Array of odometer readings.
G	Array of gallons per fill-up.
M	Array of mileage per fill-up.
R	Command mode input, also prerounded numbers sent to the rounding routine.
R$	Temporary string variable, holds operator's input.
T$	Data file name used in reading or writing with cassette.
J	Work variable, loop index.
K,L	Loop bounds
B	Number of blanks used in display formatting.
U	Number of underlines used in display formatting.
Q	String length used in display formatting.
Z	Cassette delay time during writing.

Table 2. Main variables.

data for the first time. The program will prompt the operator for the required information and then let him verify that it was entered correctly. A response of F to the verification request signals that no more data is to be entered.

Write new master file: This command causes the current data to be written on cassette for later use. The program requests a name for the file. When read later, this name will be displayed, allowing verification of the correct data file.

Display mileage data: This subroutine computes mileage (miles per gallon) from the available data. It formats all information and displays it in tabular form. Numbers are rounded to the nearest tenth so that four columns of information can be displayed on one line. When data fills the screen, the user is prompted to press the return key to continue the listing. When all data is displayed, pressing the return key will reenter command mode.

Terminate program: Ends execution and returns the computer to BASIC.

Easy Changes

Changing the value of MR in line 120 alters the maximum number of data records that the program allows. You may need to make MR smaller if you are running out of memory, or larger to accommodate additional data. MR can only be about 15 with a 4K PET. For typical data (such as in the sample run) an 8K PET will allow about 150 data records. To adjust MR, simply change its value in line 120 from its current value of 75 to whatever you choose.

Currently, the program will write a maximum of 60 data records during the cassette write operation. This number can be altered by changing the value of MW in line 120 from its value of 60 to whatever you

```
RUN
            MILEAGE
COMMANDS
1—READ OLD MASTER FILE FROM CASSETTE
2—INPUT DATA FROM TERMINAL
3—WRITE NEW MASTER FILE TO CASSETTE
4—DISPLAY MILEAGE DATA
5—TERMINATE PROGRAM
ENTER COMMAND BY NUMBER? 2
ENTER THE FOLLOWING DATA AS REQUESTED
—DATE (E.G., 1/30/78)
—ODOMETER READING (MILES)
—# GALLONS BOUGHT
DATE? 9/28/77
ODOMETER? 51051.1
# GALLONS? 14.6
  INPUT        DATE: 9/28/77
  CHECK        ODOMETER: 51051.1
               GALLONS: 14.6
    —IS INPUT OK?—
(Y = YES, N = NO, F = YES AND FINISHED)? Y
DATE?
    (10 more entries are input)
(Y = YES, N = NO, F = YES AND FINISHED)? F
    (the five commands are listed again)
ENTER COMMAND BY NUMBER? 4

 DATE      ODOMETER   GALLONS   MPG
9/28/77    51051.1    14.6      0
10/6/77    51299.7    13.8      18
10/17/77   51553.8    13.1      19.4
10/29/77   51798      13.7      17.8
11/5/77    52041.9    13.3      18.3
11/15/77   52304.9    14        18.8
11/26/77   52570.8    13.7      19.4
12/1/77    52842.5    14.6      18.6
12/9/77    53048.4    11.8      17.4
12/15/77   53359.7    14.7      21.2
12/23/77   53601.2    13.3      18.2

HIT RETURN KEY FOR COMMAND MODE
    (return key is pressed)
    (the five commands are listed again)
ENTER COMMAND BY NUMBER? 3
1) POSITION CASSETTE TAPE FOR WRITING.
2) PRESS THE CASSETTE STOP KEY.
3) PRESS THE RETURN KEY WHEN READY.
    (above is duly done)
NAME FOR FILE? VOLVO77
PRESS PLAY & RECORD ON TAPE #1
    (cassette play and record are pressed)
OK
    ________________
(a subsequent run)
ENTER COMMAND BY NUMBER? 1
1) POSITION CASSETTE TAPE FOR READING.
2) PRESS THE CASSETTE STOP KEY.
3) PRESS THE RETURN KEY WHEN READY.
    (above is duly done)
PRESS PLAY ON TAPE #1
OK
READING FILE: VOLVO77
   11 DATA RECORDS READ
```

Sample run.

choose. Only the most recent MW records will be written to tape if MW is less than the number of available records when a cassette write is issued. If the number of available records is less than MW, then all the records will be written. The value of MW should not be larger than the value of MR.

If you don't care about seeing the dates, they can be removed easily. This saves a little typing on data entry and also allows more data records in a given amount of memory. To remove this feature, delete line 320 entirely and change line 340 to read:

```
340 N = N + 1:PRINT:D$(N) = "—"
```

Suggested Projects

Calculate and print the average MPG over the whole data file. The total miles driven is D(N) – D(1). The total gallons used is the sum of G(J) for J = 2 to N. This calculation can be done at the end of the Display Mileage subroutine. Programming should be done between lines 690 and 700.

Allow the user the option to write to cassette only the entries since a certain date. Ask which date and search the D$ array for it. Then set MW to the appropriate number of records to write. These changes are to be made between lines 500 and 510 at the beginning of the subroutine to write on cassette.

Add a new command option to verify a data file just written to cassette. It would read the tape and compare it to the data already in memory.

Add an option to do statistical calculations over a given subset of the data. The operator inputs a beginning and ending date. He is then shown things like average MPG, total miles driven, total gallons purchased, etc., all computed only over the range requested.

Write a subroutine to graphically display MPG. A bar graph might work well.

Add a new parameter in each data record—the cost of each fill-up. Then compute cost of gasoline, miles/dollar, etc. ■

✓ Reader Service—see page 195

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The Fourth Faire

Here's our annual look at some people and products at the West Coast Computer Faire.

At the end of the first day of the Fourth West Coast Computer Faire (which was held in San Francisco last May 11-13), I had a tote bag filled with about two inches of product handouts, a knapsack containing several books and even one record of computer-controlled organ music, and a pair of shoes holding two tired but doggedly persistent feet. Still, I was happy—who wouldn't be with two more days of the same to look forward to?

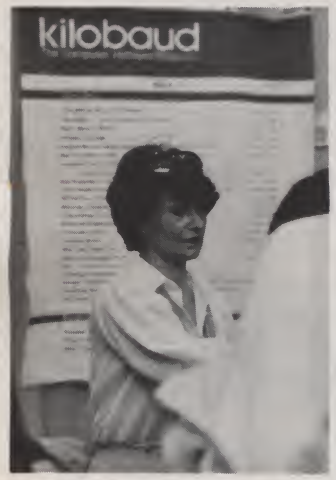
There is no possible way to describe the Faire. With 300 exhibitors taking up the Civic Auditorium; the downstairs Brooks Hall (itself large enough to host an entire trade fair); and several upstairs rooms, with lectures and papers being presented in four places at the same time during most of the Faire, I can only describe a small part of what I saw.

The show had no unexpected surprises; most new products were modest extensions of existing technology, some of which I knew about from reading the current month's computer magazines. But the real thrill came from seeing the actual products "in the flesh," from getting to use the equipment (or software) and talk to the people who developed it.

Atari always had a crowd around its new Atari 400 and 800 computer/game units; the most popular was a Trek-like game that had most of the fighting and moving done with three-dimensional graphics—the illusion of traveling through the stars was simply spellbinding. Motorola handed out information on its new 6809 microprocessor and its supporting color video interface chips. Parasitic Engineering and Micromation both showed CP/M-compatible 8-inch diskette drives for the TRS-80. I think Radio Shack was the only booth that denied all rumors of a new product.

Two languages dominated the software scene, PASCAL and FORTH. North Star demonstrated its University of California at San Diego PASCAL software. Ithaca Audio announced a PASCAL that compiles into Z-80 machine code. And Western Digital displayed its PASCAL Microengine—unfortu-

The ever-industrious George Morrow of Thinker Toys presented the Faire with the proposed IEEE Standard for the S-100 bus. The text of this standard is printed in the July 1979 issue of IEEE Computer.



Judy Waterman was kept busy by the constant flow of people stopping at the Kilobaud Microcomputing/Instant Software booth.

Claire Whalen of CAP Electronics (1884 Shulman Ave., San Jose CA 95124) was demonstrating Soundware, a combination of software and hardware (the little black box sitting on the PET is the hardware) available for the PET, the TRS-80 and the Compucolor II. The units make great sounds for games.

Steve Alcorn of MicroDaSys (Box 36051, Los Angeles CA 90036) says that his MicroDaSys computer is now available with either a 6800 or a 6809 chip. The TV monitor shows a dump of memory done with the MicroDaSys monitor program—but, unlike other monitors, the user can modify any byte shown on screen by simply writing over the byte's current value.

Janson Chang of Enerton, Inc. (2726 Middleborough Circle, San Jose CA 95132), explains his PA-EDU80 Z-80 based microprocessor trainer and self-learning set. The unit has an on-board 1K read-only memory monitor, a solderless breadboard area and a 36-key keypad. Prices start at $195 for the computer board only.

Bill Ragsdale (wearing the "FORTH Dimensions" T-shirt along with the rest of the FORTH Interest Group) is the leader of the group that has put together documentation of a standardized FORTH for all the major microcomputer chips—8080, 9900, LSI-11, PACE, 6800 and 6502. What's more amazing is that all their software is in the public domain. The group is a nonprofit organization that puts out a worthwhile newsletter priced at $5 per year. FORTH Interest Group, Box 1105, San Carlos CA 94070.

Larry Kaplan of Atari lectured and demonstrated the Atari 400 and 800 personal computers seemingly without pause for the entire three days of the Faire, a superhuman task. The Atari 400, which comes with 8K of user memory and no expansion option, retails at $549.99. The expandable Atari 800, with 8K of memory, an Atari 410 program recorder and an educational support module, is $999.99. 16K of extra memory is $249.99, and the Atari 810 disk drive is $749.99.

Gary Huckell of TNW Corporation (910 Garland Drive, Palo Alto CA 94303) displays his new TNW-2000 RS-232 Serial Interface for the PET, both with and without its enclosure.

Yes, a keyboard for those of you who are all thumbs. Actually, Bill Adams (right) built this keyboard for use by people with motor disabilities, but found that small children liked it too. Mahalo Microsystems, Box 8523, Waikiki HI 96815.

Janet Shropshire of North Star Computers (2547 Ninth St., Berkeley CA 94710) rests between demonstrations of their implementation of UCSD PASCAL.

nately, without a live demonstration. A quiet and diligently working FORTH Users' Group displayed extensive documentation for its exciting advanced language, presenting the Faire with an unheard-of coup: *de facto* industry standardization in the form of object code for the FORTH interpreter for the 8080, 9900, LSI-11, PACE, 6800 and 6502 chips.

Business systems were available but not as visible as the flashier hobbyist systems. Most of the vendors I talked to supplied the programs only, to be run on somebody else's computer; nobody seemed to be selling what is needed for this market to really lift off the ground: a software-hardware combination backed by a single vendor.

The entire Faire, like all conventions, did involve some showmanship, and those companies that put some thought (and a *lot* of programming time)

Tim Quinlan (left) is appropriately dressed to be head of Mad Hatter Software. He and Pat McMahon were staffing their double-sized booth of software for the Apple II, the PET and the TRS-80. Mad Hatter Software, 900 Salem Rd., Dracut MA 01826.

The picture here is the product of a TV camera, a Vector MZ computer and two new Vector boards, the Fast Scan Video Digitizer and the High Resolution Graphics board. Vector Graphic, Inc., 31364 Via Colinas, Westlake Village CA 91361.

Loyd Dorsett and his daughter, Dallas Dorsett-Mathers, demonstrate one version of educational materials they have been supplying for 20 years. One new twist—Dorsett Educational Systems (Box 1226, Norman OK 73070) is the sole supplier of the education programs that Atari will use for its new 400 and 800 computers.

Susan Sheridan of Compucolor (right) watches while Dawn Bell and Mark Penguin play a trial game of Othello against a Compucolor II computer. Human players beating the Compucolor program went on to play each other, with the final winner receiving a cash prize plus a trip to the regional Othello competition.

Ray Nelson of Heath Company (Benton Harbor MI 49022) is using the newly announced WH89 Package Computer. The WH89, in its standard configuration, includes two Z-80 chips (one for the video display, one for the main processor), 16K of programmable memory, a 5-inch diskette drive, a full keyboard and an 80-character, 24-line video display that supports 33 graphics characters. The price, assembled, is $2295.

into slick demonstration programs were rewarded with attentions of more potential customers. One example of this was the different responses to two very similar products—the Summagraphics Bit Pad and the Talos Digi-kit-izer.

While Summagraphics showed their product converting stylus position to a pair of X- and Y-coordinates, Talos, with their digitizer pad hooked to an Apple II, demonstrated no less than eight applications, including black-and-white or color doodling screens, area calculation for a drawn closed curve and computer-aided schematic design. I'll let you guess which booth always had a crowd.

Another aspect of this same situation is less festive. Many of the products demonstrated—particularly those working with color or graphics—depended heavily on software for their effectiveness. Unless the manufacturers support the hardware with good software, the unsuspecting computerist will find himself or herself with an impressive piece of hardware and, perhaps, neither the skill nor the patience to make it come alive.

I'll let the pictures say the rest. For those of you not fortunate enough to make it to this Faire, it's not too early to plan your vacation around the Fifth West Coast Computer Faire, to be held in the same place next spring. See you there. ■

Serial Output for the SWTP Editor-Assembler

A simple command, shown here, allows TTY machines to obtain editor or assembler output.

Marc I. Leavey, M.D.
4006 Winlee Road
Randallstown MD 21133

Users of the Southwest Technical Products Corporation's 6800 benefit from several excellent pieces of software, such as SWTP's 8K BASIC and co-resident editor-assembler. Unfortunately, while BASIC is designed to output to either serial or parallel devices, printer output from the assembler strictly goes to a parallel interface on port 7, typically an SWTP PR-40 printer. The patch described in this article changes that to an ACIA serial interface on any port. Thus, users of TTY machines, such as KSR/ASR-33, can obtain editor or assembler output with the simple PR command found in the program.

Modifying Printer Output

As written, the editor-assembler (Ver. 1.01) references the printer port at two locations. A PIA initialization routine starts at $17B1, and the character output routine starts at $1A86. Changing those routines to handle an ACIA is a clear-cut task.

The initialization routine first issues a master reset to the ACIA ($13), then sets it up for the correct clock and bit configuration ($11). It exits the routine with the same data it would have had from a PIA. The patch program as shown lists only the changed data, except for the last instruction, which is included for clarity.

Similarly, outputting through an ACIA can be accomplished well within the space required by a PIA. In fact, six fewer bytes, which are filled with NOP instructions, are required. Although the patch is shown assembled to address port 3, a table of port addresses is included, so that any I/O port may be used.

To use the program with these patches, just type PR as a command. All output will then be directed to the printer, except for the "ENTER PASS : 1P, 2P,2L,2T" during assembly, which will still appear on the control terminal. Now you can print out all those programs you've been meaning to send into *Microcomputing*, without having to call up a friend. ■

```
                          NAM    EDASPTCH
                          OPT    0
                    ***************************
                    * PATCH FOR SWTPC EDITOR- *
                    *  ASSEMBLER -- VER 1.01  *
                    * TO ALLOW USE OF PRINTER *
                    * ON ACIA LOCATED ON PORT *
                    * 3 (INSTEAD OF PIA PR-40 *
                    *       ON PORT 7.)       *
                    * BY MARC I. LEAVEY, M.D. *
                    ***************************

                    ***************************
                    * TABLE OF PORT ADDRESSES *
                    ***************************
          8000      PORT0  EQU    $8000
          8004      PORT1  EQU    $8004
          8008      PORT2  EQU    $8008
          800C      PORT3  EQU    $800C
          8010      PORT4  EQU    $8010
          8014      PORT5  EQU    $8014
          8018      PORT6  EQU    $8013
          801C      PORT7  EQU    $801C

                    ***************************
                    * INITIALIZATION OF ACIA  *
                    ***************************
     17B1                 ORG    $17B1
     17B1 CE 800C INITAL  LDX    #PORT3
     17B4 C6 13           LDA B  #$13
     17B6 E7 00           STA B  X
     17B8 C6 11           LDA B  #$11
     17BA E7 00           STA B  X
     17BC C6 FF           LDA B  #$FF
     17BE F7 01C8         STA B  $01C8

                    ***************************
                    *    OUTPUT CHARACTER     *
                    ***************************
     1A86                 ORG    $1A86
     1A86 CE 800C OUTACI  LDX    #PORT3
     1A89 A7 01           STA A  1,X
     1A8B C6 02   LOOP    LDA B  #$02
     1A8D E4 00           AND B  X
     1A8F 27 FA           BEQ    LOOP
     1A91 01              NOP                 *
     1A92 01              NOP                 * NOP'S FILL
     1A93 01              NOP                 * SPACE OF
     1A94 01              NOP                 * DELETED
     1A95 01              NOP                 * INSTRUCTIONS
     1A96 01              NOP                 *
     1A97 C6 FF           LDA B  #$FF
     1A99 FE 01CA         LDX    $01CA
                          END
```

Editor-assembler patch program.

Interfacing SOL with a Vista Disk

Vista's dual mini-floppy running CP/M works great with SOL . . . just overcome a few problems.

Fr. Thomas McGahee
Don Bosco Tech
202 Union Ave.
Paterson NJ 07502

A long, long time ago, way back in '75, I built my first computer. It was an MIL-MOD-8, based on the fabulous 8008, and as my system grew, it was my dream to someday populate my machine with 8K of memory.

Those were simpler days, when BASIC was still a rumor that everyone was working on, and 8K seemed like an awful lot of memory. We loaded programs with run-down TTYs or homemade optical readers at an unbelievable ten characters per second (Wow . . . faster than you could type!) and stayed up nights experimenting with ways to store data on cassette tapes.

Time moved on; suddenly magazines and newsletters started making the scene, confirming my suspicions that I was not alone, and that somewhere out there, there were other intelligent life forms who were, as I was, hopelessly hooked on computering as a hobby.

Where once there had been only 8008 and home-brew TTL, 8080s, 6800s and other more sophisticated chips began to proliferate. Everybody seemed to be getting into the act. Languages appeared . . . BASIC for those who could afford it (or who had friends who could afford it!) and SCELBAL for us 8008 freaks.

Suddenly 8K of memory wasn't enough. We had to have more! Many of us 8008 freaks changed over to the 8080 in desperation, simply because the 8080 could address 64K of memory as opposed to only 16K for the 8008. Sadly, we gave up our beloved octal and entered (somewhat reluctantly) the strange world of hex.

Time continues to move on, and I recently purchased a SOL-20 in kit form for use in our computer courses here at Don Bosco Tech. The kit came with 16K of memory, which I felt was adequate at the time. We started teaching programming using BASIC5, and it wasn't long before we had managed to devise programs that began to occupy all available memory.

To make matters worse, when we finally received our copy of 8K BASIC, we found that it had been renamed Extended BASIC in honor of both its extended capabilities and its appetite for memory space. Memory *space* we had; memory we didn't.

Surveying the situation, I surmised that a mere injection of a few more Kbytes was not the answer to our problem. We needed more memory, but in addition, we needed a better storage medium than our 1200 baud tape system.

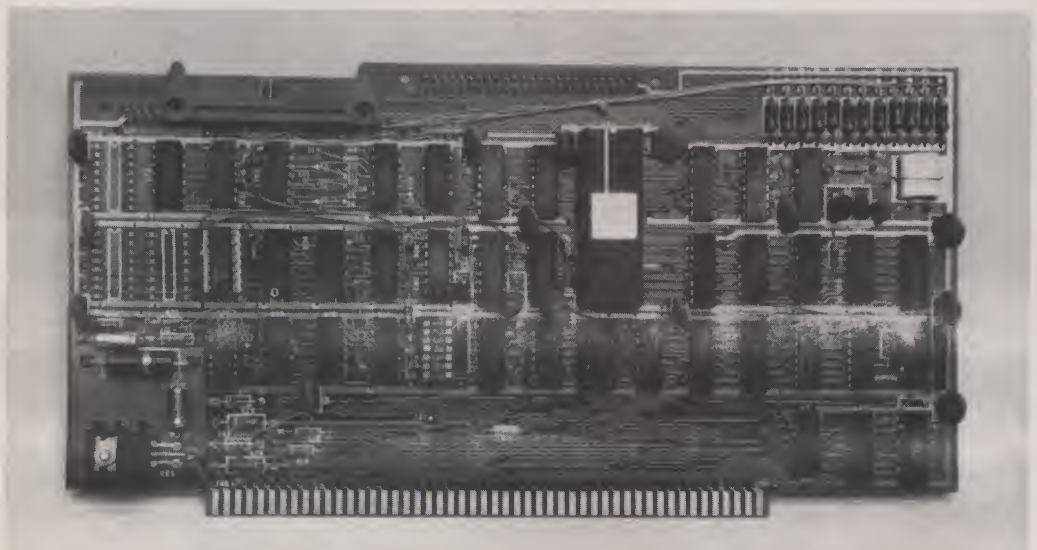
An Adequate, Inexpensive Disk System

As one who has on many occasions loaded FOCAL on a PDP-8, I can appreciate what a great advance the cassette tape is. Ten characters per second with a noisy ASR 33 TTY for half an hour just to learn you have accumulated a checksum error is a part of my past that I don't care to repeat. Cassettes are fast, but 16K programs are long, even at 1200 baud. What we needed was a disk system.

There were several disk systems available, most of which fell into one of two categories: expensive or inadequate. Some systems had limited capabilities in terms of their disk operating system, while the better systems quite naturally demanded higher prices. Furthermore, for the type of things that we would be interested in, a system with at least two disks was a necessity.

I had seen a system operating with CP/M and had been favorably impressed with the assembler, editor and dynamic debugging tool that was included with this system. CP/M had been used with 8-inch drives for some time, but a version for 5 1/2-inch diskettes was recently introduced.

Most companies that were offering CP/M for the smaller drives offered the CP/M only as



Vista controller board.

an additional-cost item, but one company, Vista Computers, was offering a disk system with CP/M software for less than what many of the other companies wanted for a system without the software.

Looking into the matter, I found out that Vista was then supplying a version that only supported a single drive but would soon be coming out with a two-drive version. I placed my order for a dual-drive version of Vista with Mini Micro Mart of Syracuse NY.

Maury Goldberg of MMM explained that he only had the single-drive version, which he would send to me for now and would send the additional drive and new software along as soon as it became available. He also mentioned that he was not sure whether the Vista would run with a SOL, but that if I had any problems he would gladly exchange the Vista for another manufacturer's comparably priced disk system that he knew for sure would work with a SOL.

Being interested in the Vista as much for its software as for its price, I decided to go ahead and give Vista a try. A friend of Maury Goldberg who had done some work with a Vista and Imsai called me to give me some pointers as to how to get the Vista CBIOS integrated into my system when it arrived. He was a bit skeptical that I would be able to do it, since the SOL has no front panel and the standard procedure requires a front panel.

I explained that often software can be made to do the same things that many people do with a front panel, and, in fact, I *was* able to get everything done using the software approach, although I must admit that a front panel would have helped during some of the hardware debugging.

Assembly and Testing

Within two weeks I received the first disk, the interface and the documentation. Originally my documentation was missing two sections, but these were received shortly from Vista Computers. During this time I mounted the first disk in a cabinet and tested out the interface. I had ordered a kit, but Mini Micro Mart sent me an assembled controller board at no increase in price, since the first few units they had received from Vista had been assembled. This was a pleasant surprise, as it allowed me to quickly begin the conversion process. Vista comes with a thick manual, which I went over carefully, paying special attention to the section dealing with the controller.

Vista dual disk and SOL computer.

The standard Vista system is configured for an Imsai computer. The onboard port addresses are normally set for the range F8-FF. This range conflicts with the SOL keyboard, status and tape port assignments. Luckily, there is a DIP switch on the Vista board that allows the user to assign the onboard ports to a different range. I decided to use the range E8-EF.

After setting up the port addressing and setting the DIP switch to disable writing and disable the onboard bootstrap, I plugged the controller into my SOL. I loaded in some test programs supplied by Vista and suitably modified by me to reflect my port addressing. I tested the drive and interface, and everything appeared to go well.

The unit would home properly, seek properly, etc., though I did note that the head was always loaded. The problem was easy to fix. Someone had failed to remove one of the shorting bars on the drive itself which programs the type of head-loading desired. I bent the appropriate shorting bar away from the socket and tried the tests again. This time everything worked fine.

A Persistent Problem

The next set of tests were designed to read and write bytes onto a sector of the disk. When I tried these routines out, weird things began to happen. Sometimes only a single byte would be read and then the system would hang up. Most of the time the system would simply hang up period, but not before filling the VDM screen with trash.

I remembered having read somewhere that certain I/O boards would not work with SOL because the SOL uses a bidirectional data bus, and most other S-100 computers keep the input and output data buses separate. Sure enough, that was part of the problem. There was a single input line, D17, on the Vista board that did not have PDBIN included in its logic circuitry.

It was an easy matter to add a new IC to the board in one of the free IC spaces provided and, using an unused Tri-state buffer, create a new line to D17 that included the necessary PDBIN signal. (Complete details of all modifications to SOL and Vista are included in the Conversion Requirements section at the end of the article.)

Program A. Author's I/O routines for CBIOS.

```
; CBIOS I/O SYSTEM
; VISTA COMPUTERS, SOLOS VERSION 2 DRIVES
; BY FR. THOMAS MCGAHEE, DON BOSCO TECH
; PATERSON, N.J. 07502   MAY 30, 1978
; THIS CBIOS ASSUMES A STANDARD SOLOS SYSTEM SUCH AS A SOL-20,
; OR AN EQUIVALENT SYSTEM WITH SOLOS SOFTWARE AND VDM.
; IT SUPPORTS A NUMBER OF UNIQUE FEATURES, SUCH AS THE ABILITY
; TO CHANGE I/O DRIVERS AT ANY TIME, SINGLE-KEY WARM BOOT,
; SINGLE-KEY CTRL U, AND A DELETE MODE THAT BACKSPACES ON THE
; VDM SCREEN, BUT PERFORMS IN THE USUAL CP/M WAY ON TTY.
; (VISTA DISK ROUTINES, WHICH ARE COPYRIGHTED, ARE NOT SHOWN).
;
;
;
SINP     EQU      0C01FH  ;SOLOS INPUT ROUTINE
SOUT     EQU      0C019H  ;SOLOS OUTPUT ROUTINE
STATFLAG  EQU     0C814H  ;FOR CONS. STATUS
LCHAR    EQU      0C815H  ;SAVES CHAR. AFTER CONST IS CALLED.
ESCFLAG EQU       0C812H  ;ESCAPE 'FLAG'
DELFLAG EQU       0C813H  ;DELETE 'FLAG' (SOLOS RAM)
;
;
```

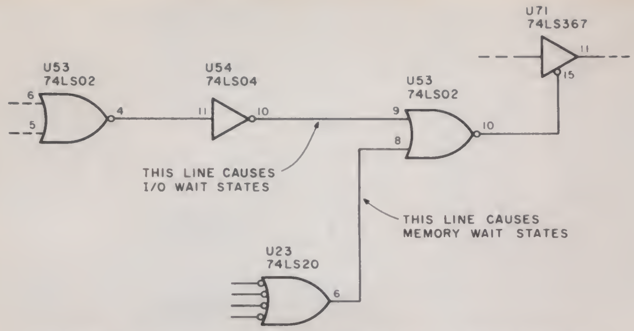


Fig. 1a. Original SOL circuit for adding WAIT states.

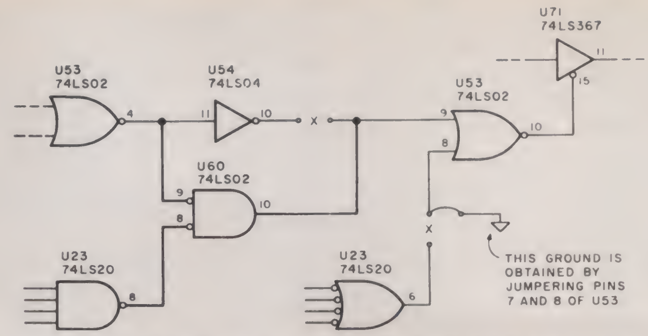


Fig. 1b. Changes to SOL to defeat off-board WAIT states.

New tests showed that the garbage was no longer generated, but the system would still hang up. Using a scope I found that the PWAIT line was holding the CPU in a WAIT state. Looking at the schematic (see Fig.1) I saw that a latching condition was being set up whereby logic on the Vista board caused a prolonged WAIT whenever certain IN instructions were executed.

Looking over the circuitry, I could see, more or less, why it was happening, but I couldn't understand why it was set up to do that in the first place. I called Vista Computers, which informed me that, for a SOL, point E47 should be connected to XRDY, not PRDY, since in a SOL system PRDY adds an extra WAIT state. I made the change but still had the problem. The more I thought about it, the more convinced I was that the basic problem lay in that PWAIT line circultry on the Vista board.

Finally, I took a piece of tape and covered up the PWAIT connector pad and plugged the board back in the SOL. I ran the program to read a sector off the disk, and lo and behold . . . success! I tested the ability of the system to write onto a disk, and again it was a success. I cut the run that connected PWAIT to the rest of the Vista board and pulled the input to U57 high with a 2k Ohm resistor to ensure that it would not accidentally trigger on noise. I also tied the EXTCR line high when I experienced some problems with this line, which is not implemented on the SOL but left floating.

Longer tests showed occasional errors that took the form of "lost" data. This was finally tracked down to the SOL board. It seems that SOL adds a WAIT state to I/O and memory requests. Vista is meant to operate in a computer with *no extra WAIT states*!

After a few minutes going over the SOL manual and schematics, I hit upon a possible solution. I took the IC that controls the extra WAIT states and bent out the lead that supplies the final signal to the processor. Sure enough, this effectively cured the problem. (A week or so after making this change I received a copy of *Solus News* in which A. T. Atey discussed another method of accomplishing the same thing. My SOL uses all high-speed memory, but it seems that some SOLs use a slower ROM than others, and these units may require the WAIT state at least for the ROM. I am including Atey's suggested changes to the SOL

```
; WRITE A CHARACTER TO THE CONSOLE DEVICE.
;
CONOT:  PUSH B          ;SAVE B,C
        MOV A,C
        CPI 0DH         ;IGNORE CR (LF=CR,LF,CR)
        POP B           ;JUST IN CASE IT WAS A CR!
        RZ
        PUSH B          ;PUSH B,C AGAIN IF NOT A CR
        CPI 0AH         ;LF NEEDS HELP!
        JMP HELP        ;TOO MUCH TO DO HERE!
CNTNU:  LDA DELFLAG     ;CHECK FOR DELETE SEQUENCE
        CPI 7FH
        JNZ NOD         ;SKIP IF NO DELETE
        MVI B,01        ;PRINT BACKSPACE
        CALL SOUT       ;SO ECHO PRINTS IN RIGHT PLACE!
NOD:    MOV B,C         ;SOLOS NEED CHAR. IN B
        CALL SOUT       ;PRINT IT.
        LDA DELFLAG     ;CHECK IF DELETE SEQ.
        CPI 7FH
        JNZ POPB        ;IF NO DELETE, WE IS DONE.
        XRA A           ;RESET DELETE FLAG
        STA DELFLAG
        MVI B,01H       ;CODE FOR VDM BACKSPACE
        CALL SOUT       ;MOVE CURSOR OVER DELETED CHAR.
POPB:   POP B           ;RESTORE B,C
        MOV A,C         ;CP/M MAY NEED IT IN A AT TIMES!
        RET
;
;
; WRITE A CHARACTER ON LISTING DEVICE.
;
LIST:   PUSH B          ;SAVE B,C
        MVI A,1         ;# OF NULLS = 1
        STA 0C810H      ;STORE IN SOLOS RAM
        MVI A,1         ;USE DEVICE #1 (TTY)
        MOV B,C         ;SOLOS PRINTS FROM B
        CALL 0C01CH     ;CALL "AOUT"
        POP B           ;RESTORE B,C
        MOV A,C         ;CP/M MAY NEED IT IN A
        RET             ;DONE.
;
; NORMALLY USED TO PUNCH PAPER TAPE, BUT IS
; SET UP HERE TO USE CONOT, SINCE USER MAY REDEFINE
; CONOT DEVICE USING CTRL/X !
;
PUNCH:  CALL CONOT
        RET             ;RETURN FROM PUNCH.
;
; NORMALLY SET UP TO READ PAPER TAPE.
; SET UP TO READ FROM CONSOLE IN STANDARD SYSTEM.
;
READER: CALL CONIN      ;READ FROM CONSOLE
        RET             ;RETURN FROM READER.

; INPUT A CHARACTER FROM CONSOLE
;PLACED HERE FOR MEMORY REASONS
CONIN:  LDA STATFLAG    ;SEE IF CONST WAS USED.
        CPI 0           ;0 MEANS NO.
        JZ  LESC
        XRA A           ;A=0
        STA STATFLAG    ;RESET STATUS FLAG
        LDA LCHAR       ;RECOVER LAST CHAR.
        JMP GCHAR       ;CONTINUE AS NORMAL
 LESC:  LDA ESCFLAG     ;GET ESCAPE 'FLAG'
        CPI 0           ;FLAG =0 IF RESET.
        JZ  REGULAR
        XRA A           ;RESET 'FLAG'
        STA ESCFLAG
        MVI A,0DH       ;LOAD A CARRIAGE-RETURN
        RET             ;'ESCAPE'=↑U AND CR
REGULAR: CALL SINP      ;USE SOL "SINP"
        JZ  REGULAR
GCHAR:  CPI 80H         ;CHECK FOR 'MODE-SELECT'
        JNZ ESC
        MVI A,03        ;CHANGE MODE-SEL INTO ↑C
ESC:    CPI 1BH         ;IS IT AN 'ESCAPE'?
        JNZ STRIP
        STA ESCFLAG     ;LOAD 1BH INTO 'FLAG'
```

✓ *Reader Service—see page 195*

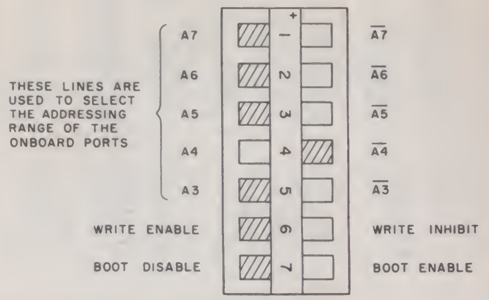


Fig. 2. Proper settings for DIP switch on Vista board when used with a SOL. The shaded squares represent the side of the switch that is down. The on-board port addressing range is selected for the range E8-EF; writing to disks is enabled; and the Vista on-board bootstrap circuitry is disabled.

Vista dual disk drives mounted in enclosure.

at the end of this article for those who may need it.)

So far only one additional problem has cropped up. It seems that the original 74LS367 bus drivers used by Vista are too sensitive to noise on the bus or have inadequate drive, causing an occasional bit of garbage on the line. I substituted 8T97s and have had no further trouble along these lines.

The people at Vista tell me that they have switched over to 8T97s, so that should be no problem to future purchasers of their system. The Vista people appear quite interested in making their system compatible with the SOL, and they have been responsive to the various suggestions that I have made to them regarding conversions for the SOL.

SOL-Vista Software

Once I had all the hardware changes made, I got down to the task of getting the software modified. The software consists primarily of a bootstrap program that is used to read in one sector, a program called SBOOT, which then reads in the Vista Operating System. The VOS, as it is called, consists of CP/M followed by CBIOS. The CBIOS is the hardware-dependent part. It contains all I/O and disk routines and is where all customization is done.

Using the standard Vista software as a guide, I wrote up a simple bootstrap loader to reside starting at CA2A. (Vista provides source listings for the bootstrap, SBOOT and CBIOS.) The major changes to the bootstrap involved changing the port addressing and setting up the error so that after an error there is a return to SOLOS rather than a HALT.

My reason for placing the bootstrap loader at CA2A is that in a SOL this is part of a 1K RAM segment that is usually not used. Every SOL has RAM in this area, and so, in addition, any software written to use this RAM area can be used directly by any SOL owner without modification.

I also wrote up a revised version of SBOOT. Again, the major change involved changing the port addressing. One other important change was: After loading in VOS, instead of

```
        MVI A,15H          ;DO A ↑U (& AUTO. CR)
STRIP:  ANI 7FH            ;STRIP OFF MSB
        CPI 7FH            ;IS IT A DELETE?
        JNZ CHANGE         ;MORE TESTS TO GO!!
        STA DELFLAG        ;SET DELETE 'FLAG'
        RET                ;(DELETE KEY NEVER ECHOED)

LFEED:  MVI B,0DH          ;PRINT CR,LF,CR
        CALL SOUT
        MVI B,0AH          ;THIS KEEPS THE VDM CLEAN
        CALL SOUT          ; BY ERASING
        MVI B,0DH          ; BEFORE WRITING.
        CALL SOUT          ;(THIS CALL MAY BE LEFT OUT).
        POP B
        RET
HELP:   JZ  LFEED          ;CR AND LF ARE SPECIAL!
        CPI 7FH            ;NEVER PRINT A DELETE!
        JNZ CTRL
        POP B              ;RETURN IF A DELETE.
        RET
CTRL:   CPI 20H            ;IS IT A CTRL CHAR.?
        JNC CNTNU          ;IF NOT, DO USUAL
        LDA DELFLAG        ;DEL SEQ.?
        CPI 7FH
        JNZ CNTNU          ;PERFORM CTRL FUNC. IF NO DEL.SEQ.
        MOV A,C            ;GET ORIGINAL CTRL  CHAR.
        ADI 40H            ;CONVERT TO PRINTABLE ASCII.
        MOV C,A            ;ROUTINE USES C
        CALL CONOT         ;PRINT ASCII FORM
        MVI A,7FH          ;SET DELFLAG AGAIN!
        STA DELFLAG
        MVI C,5EH          ;PRINT ↑ FOR CTRL CHAR.
        CALL CONOT
        POP B              ;THIS IS FROM LONG AGO!
        RET
CHANGE: CPI 18H            ;CTRL X MEANS CHANGE I/O
        RNZ
        PUSH B             ;SAVE REGISTERS!
        PUSH D
        PUSH H
INP1    CALL SINP          ;IS IT AN 'I' OR 'O' CHANGE?
        JZ  INP1
        ANI 7FH            ;STRIP MSB
        CPI 'I'            ;INPUT?
        JZ INPCH
        CPI 'O'            ;OUTPUT?
        JZ OUTCH
        CPI 'X'            ;X ALLOWS CORRECTIONS.
        JZ  INP1
        CPI 0DH            ;PORT LOADED AFTER CR.
        JZ WRAPUP
        JMP INP1           ;IGNORE TRASH.
INPCH:  CALL SINP          ;GET DEVICE CODE
        JZ  INPCH
        ANI 7FH
        CPI 'X'            ;X ALLOWS CORRECTIONS.
        JZ  INP1
        ANI 3              ;ONLY 0-3 ARE VALID.
        MOV D,A            ;STORE DEVICE CODE
        LXI H,0C806H       ;HL HAS IPORT ADDR.
        JMP INP1           ;CR ENDS CHANGE.
OUTCH:  CALL SINP          ;GET DEVICE CODE
        JZ OUTCH
        ANI 7FH
        CPI 'X'            ;X ALLOWS CORRECTIONS
        JZ  INP1
        ANI 3              ;ONLY 0-3 ARE VALID.
        MOV D,A            ;STORE DEVICE CODE
        LXI H,0C807H       ;HL HAS OPORT ADDR.
        MVI A,0            ;SET UP 0 NULLS
; THE CR,LF,CR SEQUENCE IS ALREADY THE SAME AS 2 NULLS!
        STA 0C810H         ;LOAD SOLOS NULL COUNT 'FLAG'
        JMP INP1           ;CR ENDS CHANGE
WRAPUP: MOV M,D            ;LOAD I/O PORT WITH CODE.
        POP H
        POP D
        POP B              ;RESTORE.
        CALL SINP          ;RESET INPUT PORT (IGNORE TRASH)
```

jumping into the system, I jumped back to SOLOS. This was necessary for this first version because I still had to make changes to the CBIOS.

My bootstrap program would only be of use once I got a new operating system placed onto disk, so, using cassette tape, I loaded in my version of SBOOT and then executed it. The disk drive engaged, and I could hear the telltale "click click" as the head stepped from to track-to-track. The SOLOS prompter character appeared on the screen, telling me that loading was done.

Using the DUMP facility of SOLOS, I checked the entries in the system jump table to make sure that what I had on disk and what I had in the way of documentation were the same. They were, so I proceeded to change the port addressing assignments. Once this was done, I patched in an elementary INPUT, OUTPUT and CONSOLE STATUS routine. Once this was done, I was ready to enter CP/M.

Using the documentation, I located the usual system entry point and told SOLOS to EXECUTE 5A00. The sign-on message appeared, asking me how many disks I had. By this time my second disk had arrived and been duly installed, so I typed in "2." There was a slight pause, and then the CP/M prompter symbol appeared. This verified that the patched routines were OK.

I immediately reset my SOL and SAVEd a copy of the new CBIOS on cassette tape. In case anything happened, I didn't want to have to modify the CBIOS all over again using the SOLOS ENTER command! Again I EXECUTEd 5A00. I tried having each disk read to get its directory.

It was a good thing Vista had sent me that second set of disks, because I discovered that the entire first set was blank. Imagine the amount of frustration I would have had to endure if I had tried to get my system up using one of those blank disks! Thank God for small favors!

Using one of the blank disks, I copied the editor, assembler and the two source programs, SBOOT and CBIOS, onto the disk. Then, using the editor and assembler, I modified these programs to reflect the changes necessary to make Vista run with my SOL. Once this was done, I used SYSGEN and DDT to integrate my changes into the rest of the system.

Once the new operating system had been placed onto the first two tracks of the disk, I could initiate the system by using the bootstrap program that I had written earlier. As soon as I was sure this new system was bug-free, I placed it onto all the system disks using SYSGEN.

After several days of experimenting, I found two programs that would not run with my SOL. It seems that DSCOPY and FORMAT had been specifically written for use with an Imsai computer. Using DDT, I examined each of these programs and made the necessary changes in port addressing. Once this was done, FORMAT worked just fine.

I am still having a problem with DSCOPY, which sometimes drops the first byte in a new file. The error is probably on my part . . . maybe I changed something I shouldn't have. If I could get my hands on a source listing I could find what is wrong, but for now I copy my disks using some of the other techniques available.

As I began to use the disk more and more, I began to appreciate each of the programs that are a part of the system. For those of you who do not know CP/M, let me just give a quick rundown of each program and what it does.

ED: The editor is used for writing and modifying ASCII files. It allows the user to search and substitute strings, insert and delete text, etc. It is used for preparing source files prior to assembly and also for preparing programs written in BASIC.

ASM: The assembler is used to assemble source code into 8080 object code. It follows the syntax of the Intel assembler and is also compatible with Processor Tech's assembler. One major advantage of a disk-based assembler such as this one is that you can have labels (as many as you like) up to 16 characters long. It supports conditional assembly statements.

DDT: The dynamic debugger tool has many uses. It can be

```
        JMP CONIN       ;AND JMP SO WE IS AT BEGINNING!


; CONST IS A 'KEYBOARD STATUS' ROUTINE WHICH ALLOWS CP/M
;AND OTHER PROGRAMS TO DETERMINE WHETHER OR NOT A KEY
;HAS BEEN HIT.  THIS REQUIRES THAT THE ACTUAL CHARACTER
;BE KEPT AVAILABLE FOR LATER USE...SUCH AS WHEN CONIN IS
;CALLED.  TO ACCOMPLISH THIS TASK AND STILL ALLOW THE USER
;TO USE SEVERAL DIFFERENT TYPES OF INPUT DEVICES, SUCH AS
;AN ELECTRONIC KEYBOARD AND A TTY, A SINGLE ROUTINE USES
;THE SOLOS "SINP" ROUTINE BUT STORES THE RECOVERED DATA
; IN A MEMORY LOCATION FOR LATER RETRIEVAL.  THE ONLY
;REQUIREMENT PLACED UPON THE USER IS THAT ANY "CUSTOM"
;INPUT ROUTINE MUST FOLLOW THE USUAL SOLOS CONVENTIONS
;OF RETURNING WITH DATA IN "A", AND THE ZERO FLAG SET IF
;NO DATA WAS PRESENT.
;
;
CONST:  CALL SINP        ;ANY INPUT DEVICE WORKS!
        RZ               ;0 MEANS NO DATA
        STA LCHAR        ;SAVE DATA FOR LATER.
        MVI A,0FFH       ;FF TELLS CP/M WE GOT DATA.
        STA STATFLAG     ;ALSO, FF SETS OUR FLAG.
        RET              ;THAT'S ALL, FOLKS!!
        END
*
```

```
0100              * "BYE" FOR SOL/VISTA
0100              * WRITTEN BY BRO. AL ROMAN
0100              * AND FR. THOMAS MCGAHEE
0100              * DON BOSCO TECH.
0100              * PATERSON, N.J.  07502
0100              *
0100              *
0100              * "BYE PROVIDES UTILITIES
0100              * TO MOVE PROGRAMS, CLEAR MEMORY,
0100              * BOOT IN THE DISK, AND
0100              * SEARCH MEMORY.
0100              * ALL OUTPUT IS VIA VDM/SOL
0100              *
0100                       ORG    100H   DISK LOADS IN TPA
0100 11 13 01       BYE    LXI    D,0113H  MOVE FROM 0113
0103 21 00 C9              LXI    H,0C900H  INTO SOL RAM
0106 1A             NXTBY  LDAX   D      NEXT BYTE INTO A
0107 77                    MOV    M,A    STORE IN FREE RAM AREA
0108 23                    INX    H      UPDATE ADDRESS POINTERS
0109 13                    INX    D
010A 7C                    MOV    A,H    STOP AT CB00
010B FE CB                 CPI    0CBH
010D C2 06 01              JNZ    NXTBY  DO MORE
0110 C3 15 C9              JMP    RESET  SET CUSTOM TABLE
0113              *
0113              * "MOVE" LOADS PROGRAMS DOWN
0113              * TO 0000. ACCESSED BY A
0113              * "JMP MOVE" PLACED AT 0100.
0113              * USER PROGRAM THEN FROM 0103
0113              * ETC.  AFTER MOVE, EXECUTION
0113              * BEGINS AT 0000.
0113              *
0113                       ORG    0C900H  STORED IN SOL RAM
C900 11 03 01       MOVE   LXI    D,0103H  /SEE "BYE FOR
C903 21 00 00              LXI    H,0000   /DETAILS OF
C906 1A             NEXT   LDAX   D        /OPERATION.
C907 77                    MOV    M,A
C908 23                    INX    H
C909 13                    INX    D
C90A 7C                    MOV    A,H
C90B FE C0                 CPI    0C0H   STOP AT C000: 48K
C90D C2 06 C9              JNZ    NEXT
C910 C3 00 00              JMP    0000   EXECUTE AT 0000.
C913 00                    NOP    .      CLEAN UP ADDRESSES
C914 00                    NOP
```

used to disassemble object code into 8080 mnemonic code. It can be used to examine and alter memory (you do the altering in assembly language!) or give a combined hex and ASCII listing of data in memory. You can use it to fill portions of memory with any given character. Its most important use, however, is in tracing through a program. At each step it gives the contents of all registers and flags, each conveniently labeled, as well as the current instruction in mnemonic code. Should the user try to trace any program segment that is within or above CP/M's control section, this portion will be executed in real time. This allows disk commands to be done at the proper speed. Tracing resumes upon return from these upper program areas. In single-disk systems, DDT also furnishes a fast means of making copies of command files.

PIP: The peripheral interchange program allows the user to copy and transfer files within a disk, from disk-to-disk, disk-to-peripheral, peripheral-to-disk and from peripheral-to-peripheral. In addition, it allows two or more files to be appended. The buffer area used by PIP is small, and copying disks with PIP on a single-disk system involves a lot of disk changing.

DSCOPY: This disk copy program is supposed to transfer the contents of one disk onto another. It is only useful in a two-disk system.

SUBMIT: The submit program allows the user to perform a chain of operations under stored program control. Using the editor, the user writes a submit file that includes all the operations he wants performed. This file must have the file-type SUB. When the user types SUBMIT (filename).SUB, the named file will be used to build up a set of command lines that will be executed in sequence. This is useful for having the system perform lengthy routines such as making multiple program listings. Once the program is entered, the user can leave the system unattended and get busy doing something else.

LOAD: This program allows the user to load tapes in Intel hex format. (By the way, the assembler produces a hex listing in this format. Such formats are loadable directly under DDT or may be made into a runnable command file using LOAD.) A file with filetype COM is produced which is directly executable.

DUMP: This program produces a hexadecimal dump of a disk file. The contents of the file are listed 16 bytes at a time, with the absolute byte file address listed to the left of each line in hex.

DSKCAS: Used for transferring disk files to Tarbell cassette. I have not used this since I don't have a Tarbell interface.

CASDSK: Used for transferring Tarbell cassettes to disk. I have not used this routine.

FORMAT: Blank disks must be formatted before they can be used. Vista uses a soft-sectored diskette that is IBM-format-compatible. Formatting a disk erases all previous contents.

SYSGEN: This program allows the user to place operating systems onto disk. It does not affect any of the other contents of a disk.

CPM: This program allows the user to re-configure his operating system for different memory sizes. It builds a new operating system, to which the user must append versions of SBOOT and CBIOS reassembled for the desired memory size.

STAT: This program checks the disk and tells you how much memory space is still available.

CBIOS and SBOOT: These are source listings of the programs the user may have to or want to modify using the editor and the assembler. Modification is relatively direct for anyone who can work in assembly language.

BASIC: This program reads a file written in BASIC and produces a numbered listing, flags errors and builds up a file that is runnable. The BASIC supplied is BASIC-E. An excellent manual for this particular BASIC is available from JEM Company, Suite 301, 2555 Leavenworth St., San Francisco CA 94133. When I purchased mine, the cost was $25 for the manual and $1.50 postage. (C-BASIC is also available from Vista on their diskette. Write them for the current price.)

RUN: This program will read and load the program compiled by BASIC. Run-time errors are

```
C915                 0046 *
C915                 0047 * RESET CUSTOM COMMANDS
C915                 0048 *
C915 21 3C C8        0049 RESET   LXI    H,0C83CH
C918 11 26 C9        0050         LXI    D,DATA
C91B                 0051 *
C91B 1A              0052 MOR     LDAX   D
C91C 77              0053         MOV    M,A
C91D 23              0054         INX    H
C91E 13              0055         INX    D
C91F B7              0056         ORA    A       * CUST. NEVER 00
C920 C2 1B C9        0057         JNZ    MOR
C923 C3 C9 C1        0058         JMP    COMND
C926                 0059 *
C926 46 43           0060 DATA    ASC    'FC'
C928 3B C9           0061         DW     FCHR
C92A 46 4E           0062         ASC    'FN'
C92C C2 C9           0063         DW     FNUM
C92E 53 43           0064         ASC    'SC'
C930 E1 C9           0065         DW     SCRN
C932 44 49           0066         ASC    'DI'
C934 2A CA           0067         DW     DISK
C936 43 4C           0068         ASC    'CL'
C938 1B CA           0069         DW     CLEAR
C93A 00              0070         NOP    .          END OF TRANSFER
C93B                 0071 *
C93B                 0072 * LOCATE TWO CONSECUTIVE CHARACTERS
C93B                 0073 *
C93B                 0074 *    ON SCREEN:  ADDRESS OF FIRST CHARACTER
C93B                 0075 *     (BLINKING) FIRST CHARACTER
C93B                 0076 *
C93B CD 1B C3        0077 FCHR    CALL   SBLK    ADDRESS OF CHARACTERS
C93E EB              0078         XCHG   .       INTO H-L
C93F 56              0079         MOV    D,M
C940 23              0080         INX    H
C941 5E              0081         MOV    E,M
C942                 0082 *
C942 CD D5 C0        0083         CALL   PERSE   CLEAR SCREEN
C945 42              0084         MOV    B,D
C946 CD 19 C0        0085         CALL   SOUT    PRINT CHARACTER
C949 43              0086         MOV    B,E
C94A CD 19 C0        0087         CALL   SOUT
C94D CD 06 C4        0088         CALL   BOUT
C950 21 FF FF        0089         LXI    H,-1    START AT 0
C953                 0090 *
C953 E5              0091 NEXTC   PUSH   H       PREPARE RETURN ADDRESS
C954 21 53 C9        0092         LXI    H,NEXTC
C957 E3              0093         XTHL   .       DONE.
C958                 0094 *
C958 CD AD C9        0095 NXTL    CALL   SINX    INCR. HL & CHECK MEMORY
C95B 7E              0096         MOV    A,M
C95C E6 7F           0097         ANI    7FH     NEGATIVE IS SPACE
C95E BA              0098         CMP    D       1ST
C95F C2 58 C9        0099         JNZ    NXTL
C962 CD AD C9        0100         CALL   SINX
C965 7E              0101         MOV    A,M
C966 E6 7F           0102         ANI    7FH
C968 BB              0103         CMP    E       2ND
C969 C2 5B C9        0104         JNZ    NXTL+3
C96C D5              0105         PUSH   D       SAVE DATA
C96D 2B              0106         DCX    H
C96E                 0107 *
C96E E5              0108 HERE    PUSH   H       NEXT OCCURRENCE
C96F E5              0109         PUSH   H       ADDR & START OF SCREEN
C970 CD 06 C4        0110         CALL   BOUT
C973 CD E8 C3        0111         CALL   ADOUT   ADDRESS
C976 E1              0112         POP    H
C977 7C              0113         MOV    A,H
C978 D6 01           0114         SUI    1
C97A 57              0115         MOV    D,A
C97B 5D              0116         MOV    E,L
C97C 26 CE           0117         MVI    H,0CEH    FROM 9TH LINE DOWN
C97E 2E 00           0118         MVI    L,0
C980 CD B7 C9        0119         CALL   DMP     ON SCREEN
C983                 0120 *
C983 21 00 CF        0121         LXI    H,0CF00H  BLINKING
C986 7E              0122 LOOP    MOV    A,M
C987 EE 80           0123         XRI    80H
C989 77              0124         MOV    M,A
```

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flagged using two-character error codes (alphabetical).

In addition to the above, there are certain commands that are resident whenever the system is waiting for a command line. These commands include:

DIR: The directory is listed.

ERA: The specified file is erased. (Actually, I believe only the directory information is erased and the file space freed. The actual file seems to remain but is written over later on if the space is needed.)

TYPE: Any file containing ASCII information can be listed using the TYPE command.

On a single-disk system, the user can do most things that can be accomplished in a dual-disk system, but they take longer. Instead of actually changing disk drives, the system will prompt the user by telling him which disk (A or B) to insert in the drive.

Software Modifications

I often use our Vista disk and have recently written up a new, more sophisticated CBIOS (see Program A) that I have made available to Vista for use by SOL owners. This new CBIOS corrects some output problems that appeared when using the VDM for output: Certain command lines would be erased when the "return" key was hit; they were entered and executed, but the user could not see them any more on the screen.

I corrected this problem by arranging the output program to ignore carriage-returns and to expand line-feeds into the sequence CR,LF,CR. This keeps the VDM display clean by erasing trash on the current line (which may be there after a delete sequence) and ensures that the next line is also erased. The extra CR is easily removed for those who prefer to do without it. The expanded sequence also eliminates the need for nulls when using a TTY.

I did not particularly like the way CP/M handled deletions by echoing them. When long deletions were done, the mass of characters, which are echoed in reverse, was too much of a distraction. For example, to correct the line, "SPELING ERROR" would result in the following line: "SPELING ERRORRORRE GNILING ERROR."

What I did was arrange the input and output routines so that whenever a DELETE key was hit, a software flag was set. When the output routine is called and it is determined that a delete sequence is under way, it handles it by inserting appropriate back spaces both before and after the character is echoed, so that on the VDM screen the cursor is seen to back up. It should be noted that on a TTY the delete sequence appears in the normal way, since there is no back space executed.

Another important addition to the CBIOS that I made is the ability to change I/O devices at any time without returning to SOLOS. My INPUT routine, called CONIN, detects when the user has entered a control X character and jumps to a routine that then allows the user to specify which of four input or four output devices is desired. When the "return" key is hit, the user-supplied information is converted to information stored in the SOLOS RAM status area.

SOLOS then uses this information to determine the current I/O ports on all subsequent input and output operations. The change-of-I/O sequence is done without any echoing. This is so no unwanted characters will appear on the current listing device. The ability to change I/O at any time is especially useful when the user only wants a partial listing printed out.

I do all my editing, for instance, with the VDM screen, but when I want hard copy of a given section, I switch over to our TTY. The devices supported are those supported by SOLOS, and they include the keyboard and VDM, serial input and output (such as a TTY), parallel input and output and a user-defined input and output custom routine.

I have also made available to Vista a revised version of SBOOT and a set of utility programs together with a version of FORMAT that will run with a SOL. All of these are available on a single disk with a runnable disk operating system that includes all the refinements mentioned earlier. A source listing of SBOOT and CBIOS is also in-

```
C98A 16 80            MVI   D,80H   RATE OF BLINKS
C98C 13               INX   D
C98D 14               INR   D       SET FLAGS
C98E 15               DCR   D
C98F C2 8C C9         JNZ   $-6
C992 CD 1F C8         CALL  SINP    WAIT FOR ANY CHARACTER
C995 CA 86 C9         JZ    LOOP
C998             *
C998 FE 1B            CPI   1BH     ESCAPE?
C99A CA C9 C1         JZ    COMND   BACK TO SOLOS
C99D 3A 09 C8         LDA   LINE
C9A0 FE 07            CPI   7       RESTART LINE
C9A2 3E 01            MVI   A,1
C9A4 FA AA C9         JM    $+3
C9A7 32 09 C8         STA   LINE
C9AA E1               POP   H
C9AB D1               POP   D
C9AC C9               RET   .       TO NEXTC OR NEXTN
C9AD             *
C9AD 23          SINX INX   H
C9AE 3E FF            MVI   A,0FFH  LAST ADDRESS IN 'L'
C9B0 BD               CMP   L
C9B1 C0               RNZ
C9B2 BC               CMP   H       LAST ADDRESS IN H (SAME)
C9B3 C0               RNZ
C9B4 C3 C9 C1         JMP   COMND   BACK TO SOLOS
C9B7             *
C9B7 1A          DMP  LDAX  D       FROM TEXT..
C9B8 77               MOV   M,A     TO SCREEN
C9B9 13               INX   D
C9BA 23               INX   H
C9BB 7C               MOV   A,H
C9BC FE D0            CPI   0D0H    LAST ADDRESS
C9BE C2 B7 C9         JNZ   DMP
C9C1 C9               RET
C9C2             *
C9C2             * LOCATE ONE HEXADECIMAL NUMBER (TWO ASCII)
C9C2             *
C9C2             *   ON SCREEN:  ADDRESS OF HEX NUMBER
C9C2             *     (BLINKING) HEXADECIMAL NUMBER
C9C2             *
C9C2 CD 3A C3    FNUM CALL  SCONV   GET NUMBER
C9C5 55               MOV   D,L
C9C6 CD D5 C0         CALL  PERSE
C9C9 7A               MOV   A,D
C9CA CD ED C3         CALL  0C3EDH  PRINT NUMBER
C9CD 21 FF FF         LXI   H,-1    START AT 0
C9D0             *
C9D0 E5          NEXTN PUSH H       PREPARE RETURN ADDRESS
C9D1 21 D0 C9         LXI   H,NEXTN
C9D4 E3               XTHL  .       DONE.
C9D5 CD AD C9    NXTN CALL  SINX    INCR. HL & CHECK MEMORY
C9D8 7E               MOV   A,M
C9D9 BA               CMP   D
C9DA C2 D5 C9         JNZ   NXTN
C9DD D5               PUSH  D       SAVE DATA
C9DE C3 6E C9         JMP   HERE    NEXT OCCURRENCE
C9E1             *
C9E1             * DUMPS MEMORY TO SCREEN
C9E1             *        ENTER ADDRESS IN HEXADECIMAL
C9E1             *
C9E1 21 1C C8    SCRN LXI   H,0C81CH  BUFFER
C9E4 06 03            MVI   B,3
C9E6 CD 6E C4         CALL  0C46EH  GET NAME
C9E9 CD 3A C3         CALL  SCONV   GET ADDRESS
C9EC E5               PUSH  H
C9ED E5               PUSH  H
C9EE CD D5 C0         CALL  PERSE   CLEAR SCREEN
C9F1 16 04            MVI   D,4
C9F3 21 1B C8         LXI   H,0C81BH  BUFFER -1
C9F6 CD 6A C5         CALL  0C56AH  PRINT IT
C9F9 E1               POP   H
C9FA CD E8 C3         CALL  ADOUT
C9FD CD 36 C1         CALL  0C136H  REMOVE CURSOR
CA00 E1               POP   H
CA01             *
CA01 EB               XCHG  .       INTO D-E
CA02 AF               XRA   A
CA03 32 09 C8         STA   LINE    SET POINTER
```

cluded so the user can add refinements of his own.

There is a special program on this disk that is called BYE (see Program B). This program was written by Bro. Al Roman (also from Don Bosco Tech and the other instructor in our computer course) and myself. This program contains a number of utilities that are loaded into the SOLOS system RAM area that resides between SOLOS and the VDM memory. I used this area because every SOL has it, and, in most cases, it isn't used.

When this program is loaded, it relocates itself and initializes a set of custom commands. These custom commands are DI, which will load in the disk system, FC, which will allow the user to find where a pair of characters is located in memory, FN, which does the same thing but uses a hexadecimal digit as the search character, CL, which clears memory, and SC, which displays "pages" of memory on the VDM. These utilities allow fast searches of memory. The current address is displayed on the top line, and the rest of the screen is filled with a visual memory image.

In the case of FC and FN, the character that is found is displayed at the left of the screen —at about the middle—and is made to blink under software control. This aids in quickly spotting the character. Since the found character is shown at the approximate middle of the displayed memory area, the user can see the character "in context" and more easily determine if that is the character or pair that he is interested in. Hitting any key will cause the program to search for the next occurrence.

Bro. Al and I have made extensive use of these utilities for finding where specific things of interest are located in memory. It should be noted that if the custom commands are destroyed (as they are whenever a system reset occurs!) they may be reinstated by typing in "EX C915" while under SOLOS command. This will cause the custom commands to be rewritten into the proper place. If power is removed, everything is lost, unless your memory has battery backup.

Another thing that is loaded in by BYE, but which has no corresponding custom command name, is a short routine that will move a program from the CP/M Transient Program Area down to 0000 and begin execution there. We use this to move programs such as BASIC5, TARGET, TREK-80 and the ELECTRIC PENCIL.

We have also put such things as Extended BASIC and the ALS-8 assembler onto disk. We load these a bit differently due to either their size or where they have to be loaded in memory. This disk system loads all executable files starting at 0100, so if a program runs elsewhere, it must first be relocated.

Before I go into the details of the conversion necessary to make a SOL and Vista compatible, I'll mention that the Vista drive is a Shugart SA 400 Minifloppy drive, the same drive used by many other companies offering disk systems for the computer hobbyist. The Vista interface board is licensed from Tarbell and is indentical, as far as I can tell, to the standard Tarbell disk interface.

This board uses the Western Digital 1711 controller chip, and, should the user ever desire to upgrade to a full-size floppy, the interface board will probably be fairly easy to convert for this purpose, since the options are all jumper-selected. Diskettes are soft-sectored, such as DYSAN #800130 or VERBATIM MD 525-01 (#4443 if ordered by the box). The price per disk runs between $4 and $5 depending on the vendor and the quantity purchased. A disk must be formatted before it can be used.

```
CA06 3E 04                 MVI    A,4
CA08 32 08 C8              STA    LINE-1
CA0B 21 40 CC              LXI    H,0CC40H   ACTUAL TRANSFER..
CA0E CD B7 C9              CALL   DMP        ON SCREEN
CA11 31 FF CB              LXI    SP,0CBFFH
CA14 3A 07 C8              LDA    0C807H
CA17 F5                    PUSH   PSW
CA18 C3 D7 C1              JMP    0C1D7H   EXIT WITH 'MODE-SELECT'
CA1B                  *
CA1B                  * CLEAR MEMORY
CA1B                  *
CA1B 21 00 00         CLEAR  LXI    H,0      FROM ADDRESS..
CA1E 36 20            MORE   MVI    M,20H    SPACES
CA20 23                      INX    H
CA21 7C                      MOV    A,H
CA22 FE C0                   CPI    0C0H     END OF MEMORY: 48K
CA24 C2 1E CA                JNZ    MORE
CA27 C3 C9 C1                JMP    COMND    DONE.
CA2A                  *
CA2A                  * DISK BOOTSTRAP LOADER
CA2A                  * ACCESSED BY "DI" CUSTOM COMMAND.
CA2A                  * ASSUMES VISTA INTERFACE PORTS SET
CA2A                  * FOR PORT NUMBERS IN THE RANGE "E0-EF"
CA2A                  * NOT STANDARD VISTA "F0-FF" RANGE, SINCE
CA2A                  * SOL SYSTEMS USE THE "F0-FF" PORTS
CA2A                  * FOR VDM/KBD, ETC. !
CA2A                  *
CA2A 3E 00            DISK   MVI    A,00     TRACK=00
CA2C D3 EB                   OUT    0EBH     DISK GETS TRACK #
CA2E 3E 13                   MVI    A,13H    LOAD "SEEK" COMMAND
CA30 D3 E8                   OUT    0E8H     ISSUE "SEEK" COMMAND
CA32 DB EC                   IN     0ECH     WAIT FOR HOME
CA34 AF                      XRA    A        COMPLETE.
CA35 6F                      MOV    L,A      SET L=0
CA36 67                      MOV    H,A      SET H=0
CA37 3C                      INR    A        SET A=1
CA38 D3 EA                   OUT    0EAH     SECTOR=1
CA3A 3E 8C                   MVI    A,8CH    CODE FOR "READ"
CA3C D3 E8                   OUT    0E8H     DO SECTOR READ
CA3E DB EC            RLOOP  IN     0ECH     WAIT FOR DRQ OR INTRQ
CA40 B7                      ORA    A        SET FLAGS
CA41 F2 4B CA                JP     RDONE
CA44 DB EB                   IN     0EBH     READ A BYTE OF DATA
CA46 77                      MOV    M,A      PUT INTO MEMORY
CA47 23                      INX    H        INCREMENT POINTER
CA48 C3 3E CA                JMP    RLOOP    DO IT AGAIN
CA4B DB E8            RDONE  IN     0E8H     READ DISK STATUS
CA4D B7                      ORA    A        SET FLAGS
CA4E CA 7D 00                JZ     07DH     IF ZERO, GO TO SBOOT !
CA51 C3 C9 C1                JMP    COMND    IF ERROR, GO TO SOLOS

BYE    0100    CLEAR  CA1B    DATA   C926    DISK   CA2A
DMP    C9B7    FCHR   C93B    FNUM   C9C2    HERE   C96E
LOOP   C986    MOR    C91B    MORE   CA1E    MOVE   C900
NEXT   C986    NEXTC  C953    NEXTN  C9D0    NXTBY  0106
NXTL   C958    NXTN   C9D5    RDONE  CA4B    RESET  C915
RLOOP  CA3E    SCRN   C9E1    SINX   C9AD
```

Conversion Requirements

Throughout the text I have mentioned in general terms what steps I had to go through in order to get my SOL and Vista running together. The following is a more detailed account of everything that needs to be done. Some things are mentioned that *may* need to be done with some SOL units, but not with others.

I found only one change necessary to the SOL itself. Remove U71 and bend pin 11 away from the body, so that when it is reinserted in its socket, pin 11 makes no connection. This defeats *all* memory and I/O WAIT states. (If you have slow ROM then you may need a further conversion that will be detailed later.)

The following changes refer to the Vista/Tarbell board. Check U24 and U30. If they are 74LS367s, change them to 8T97s. (Newer boards may be shipped with 8T97s as standard parts.)

Add a pull-up resistor to the EXTCR line (S-100 bus, pin 54). Any 1/4 or 1/2 Watt resistor in the 1k to 3k range will work. I found a convenient place to be the bottom of the board, placing the resistor between the feed-through from S-100 pin 54 and +5 volts from pin 16 of U30.

If there is a jumper going to E47, remove it. (E47 is just below the DIP switch.) Jumper E48 to E46. (E46 is S-100 bus pin 3, and E48 is about half an inch above E46.) These changes connect the onboard WAIT circuitry to the XRDY line.

Find the run that goes from the S-100 bus pin 27 (PWAIT) to U57, pin 14. *Cut this run.* Now add a 1k to 3k pull-up resistor between pins 14 and 16 of U57. This stops unnecessary WAITs.

The next change to the Vista board is to add the necessary PDBIN logic to the D17 line (S-100 bus pin 43). On the particular board I purchased there were four empty IC stations. I used the empty U46 location for my additional IC. Solder a 7432 or 74LS32 into the U46 position. Solder a short jumper from pin 7 of U46 to the ground bus located just below. Solder a jumper from pin 16 of U46 to the +5 volt bus located just above this pin.

On the bottom of the board, cut the run that comes from pin 11 of U30. Cut it about halfway along its length. On the run just cut, there is a feed-through. Solder a jumper between this feed-through and pin 3 of U30. This procedure removed the original bus driver from providing the D17 signal and placed a new bus driver onto this line. (Pin 3 of U30 now connects to S-100 bus pin 43.)

Now we have to connect the proper input signal to our new driver. Connect a jumper between 2 and 12 of U30 (or you can connect between pin 2 of U30 and pin 1 of U45, which happens to have a feed-through right next to it, which makes soldering a bit easier).

The control line of our new driver needs a control signal that includes the original signal and a suitable PDBIN signal. Pin 3 of U3 has just such a signal, so connect a jumper between pin 3 of U3 and pin 1 of our U46. (This jumper is best placed on the top of the board.) The other signal that we need is labeled IO* on the Vista schematic and is found at pin 4 of U29. Connect a jumper between pin 4 of U29 and pin 2 of our U46. This completes the changes made to the Vista board.

Try out your system. If you still have difficulty, it may be because your particular SOL has a slow ROM and needs the on-board WAIT states. Fig. 1 shows a way to defeat off-board WAIT states while still retaining on-board WAIT states. These changes to the SOL are made in such a way that no new ICs are added, and no lands are cut. This information appeared in Special Issue No. 1 of *Solus News*, PO Box 23471, San Jose CA 95153, in a hardware review by A. T. Atey (which I assume is a pen name). I have tried the modifications out in my SOL, and they work. Many SOLs will *not* require the modifications shown in Fig. 1.

Conclusion

In closing, I would like to say that although it took me some time and a little frustration before I finally got my Vista and SOL working well together, future users should not have much trouble if they follow the steps listed in this article. And whatever else you do, if you do order a Vista for your SOL, tell the Vista people that it *is* for a SOL, so they can provide you with the appropriate software and documentation. There is no need for you to have to duplicate work that has already been done.

I have found the Vista system with CP/M to be a most useful tool, and I am sure that there are many others who could benefit from owning such a system. It may require a little work to get running, but once it *is* running, it *saves* a lot of work! ■

Fr. Thomas McGahee teaches electronics and computer courses at Don Bosco Technical High School in Paterson NJ. He has been involved in teaching computer-related courses since 1972 when he taught computer programming at Don Bosco Tech in Boston. In 1974 he got involved in the computer hobby field. Since then he has built computers based on the 8008, 8080, Z-80 and 6800 microcomputer chips. His interests are related to both hardware and software, and he has written articles that have been published in several of the magazines that serve the computer hobby field.

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The Failure of a Micro in Business

Microcomputers are miraculous, but not magic. Public education about micros is needed.

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I am a partner/programmer in MCT Microcomputer Consultants. We have been writing programs and advising people on microcomputers since June 1978. We have chosen to specialize in the Radio Shack TRS-80 because of the local lack of any other programmers, capable or willing to work on it, although we have worked on several other computer systems when necessary.

This article is a description of a recent project in which we were involved.

Background

In November 1978, a customer called us to discuss the possibility of using a Radio Shack microcomputer in his business. He was the owner and operator of a foreign-car salvage yard, and he wanted to use the TRS-80 to keep track of the cars and parts that made up his inventory.

At first this seemed to be a relatively simple request, until he explained that he also wanted the microcomputer to be able to cross-index the parts so that it could search the inventory for a part to replace another *part not* necessarily from the same model and year of car.

For example, he wanted to be able to ask the computer if he had a door that would replace the door of a 1974 Datsun 240Z. The computer would check the inventory of Datsuns to see if any of them had a door that would fit the 240Z, even if it came from a 1978 Datsun 200SX.

This meant that not only did we have to keep track of the cars and the parts available on the cars, but also all the other models that each of those parts would fit.

After studying his needs, the Radio Shack system and the other systems available, we suggested that he purchase a North Star microcomputer with 32K RAM and two double-density mini-disk drives. This system would be able to keep his entire inventory on only three or four disks, with the majority of the most-requested cars on-line in the two drives.

The Radio Shack system he had looked at included 32K RAM and two single-density mini-disk drives. He would need five to eight mini-disks to cover his inventory and the matches, with only one-third available on-line at any one time.

The North Star system was given a delivery time of two to three months, while the Radio Shack store promised delivery within one month. Since he wanted the system as soon as possible, he purchased the Radio Shack system. The Radio Shack system included: one CPU with 16K RAM, Level II BASIC; one expansion interface with 16K RAM; two mini-disk drives, 89,600 byte storage each; one video monitor. Each of these items required a separate socket, for a total of three 2-outlet wall sockets.

Because of the uniqueness of his inventory requirements, there was nothing commercially available capable of doing what he desired, so we wrote his program ourselves and charged $240.

When we had the program running to our satisfaction in our office, we stopped and packed up the equipment to take it to his office for final revisions and touch-up work.

Problems

During our programming, the only problems we encountered were DATA READ ERRORs from the mini-disk drives. Although these were annoying, they were not fatal, and when we checked with Radio Shack we were informed that a hardware solution was available at their repair facility . . . no charge.

The next morning when we had the system set up at the salvage-yard owner's office, we reviewed the flowchart of the program with him and showed him how we had the program set to work. Following his criticisms, we started making the alterations and additions he had requested.

It was at this point that we noticed we were having line voltage problems: the video monitor was flickering every few minutes and fading at times. At that moment we didn't really think about it, as the video monitor had also been flickering at our office, though not nearly as frequently.

At 11 AM we had a power brownout. The monitor went off, then on, and the computer did an auto-reset. We turned everything off, then back on again, and reloaded the program from the disks. We asked the owner if he had any unusually heavy-duty power tools that might cause such a brownout. He said no.

Less than an hour later another brownout lost us half of our RAM memory, and we were again forced to do a dead-start. This time the owner shut down his yard, leaving on only the computer and room lights. The video monitor still flickered.

At one o'clock the program crashed. Upon inspection, we discovered that portions of the memory had been altered. For example, a DATA instruction had been changed to MERGE. Letters were changed in PRINT statements, and some commas were changed to dollar signs. We again reloaded the program. There were no errors and it ran properly. However, after 20 minutes it also crashed. Again there were errors.

Four times we tried to run the

program. Each time things worsened.

Finally, entire portions of the program were being deleted, including one loss of over 10K of instructions. Also, our DATA READ ERRORs increased to the point where we were unable to load the program from the disks without trying four or five times.

For a while, we thought we were in The Twilight Zone.

We finally decided to shut down completely and return the system to our office, where most of the problems disappeared—but not all. We still encountered DATA READ ERRORs every other time we tried to access the mini-disk drives, and there were *still random* alterations to characters in the program.

Troubleshooting

We called T.G. & E., the local electric power company, and asked them to check out the salvage yard's power lines for unfiltered spikes and surges. We also had them check out the local microwave transmission and reception routes to see if the salvage yard might be within one of these paths and accidently receiving some interference.

Late the next day, the T.G. & E. representative called and told us that the salvage-yard power lines were within normal specifications and that there was no detectable amount of microwave radiation above normal background levels. He also told us the interference probably came from a major arc-welding outfit only five telephone-pole spans away.

He informed us that heavy industrial welding could send voltage spikes as high as 10,000 to 100,000 volts through the lines, and that they could pull an entire power sub-grid down to 90 volts for short periods of time.

After consulting with the computer specialists at T.G. & E., we concluded that the salvage yard would need power-line filters in order to protect the microcomputer from those spikes, surges and low voltages. Because the Radio Shack system he had was composed of five subassemblies, each with its own power cord, this meant four outlets had to be supplied (the video monitor didn't really have to have filtered power).

After checking around, we found that the cheapest adequate filtration power supply cost $75 and was equipped with only one outlet, rated at 65 Watts. The next choice was a $100 single-outlet Unitrol filtered power supply rated at 400 Watts.

Both of these power supplies were designed to maintain a constant 120 V ac output, even if the input dropped to 90 V ac. Both devices were made for color photography enlargers, and should be available at most photography stores.

An Ultimatum

When we informed the salvage-yard owner that he would have to have these additional devices, he became very upset. He thought that the Radio Shack computer was at fault for not being properly protected in the first place.

Because we were still having problems with the changing characters in the program, we decided to give it a RAM test. We discovered that several high-address RAMs were now faulty, and that the expansion interface would have to be sent to the regional repair center. The Radio Shack store we were dealing with said it would take about seven days.

The salvage-yard owner gave Radio Shack an ultimatum: either replace the expansion interface within 24 hours or cancel the entire deal. Since there was a two-month back-order wait for a new interface, this was not possible. The Radio Shack store refunded his money and took back the equipment.

As far as our program was concerned, he felt that we had honored our part of the contract with him in supplying him with a working program that did what he wanted, so he paid us the agreed amount in full.

In Retrospect

Looking back over this experience, we can see several factors that contributed to the failure of this project.

First: the unrealistically high expectations of the customer. He expected 100 percent perfection of both hardware and software. The Radio Shack computer had been originally designed with the hobbyist in mind, not as serious competition to business computers. Because of this difference in market aim, ultra-high reliability was not considered worth the additional money it would have required.

The computer was designed for the home environment, not heavy-duty business applications in an industrial park. Also, because of its new position on the market, the Radio Shack computer is still encountering flaws in both hardware and software, which are being corrected as fast as possible.

Regarding software, the owner couldn't understand why it would take more than a week to just write the program, much less debug it. Even after talking with us, he couldn't understand why Radio Shack couldn't guarantee 100 percent reliability on the first sale, nor could he understand why we couldn't guarantee 100 percent perfection the first time we ran the program.

Second: the lack of personnel at the Radio Shack store with adequate knowledge of both their computer and programming. Questions that they should have been able to answer, they could not.

Third: our own lack of information about the stability of the power lines and the possible effects they could have on the microcomputers.

For the Professional

We suggest that before you agree to sell a computer or write a program for a computer that the customer will buy, you do the following:

1. Educate the customer on the problems that all microcomputers have, both hardware and software.

2. Check the environment in which the computer will be placed. Are dust, temperature, atmosphere or power lines likely to be problems? If there is the slightest possibility of a yes on any of these, notify the customer, preferably in writing. The most important thing to remember is that the customer is depending upon you to tell him about any problems you foresee. After all, you are the expert, aren't you?

For the Businessman

Before you purchase the equipment, make sure you understand its limitations. Nothing works perfectly; to expect anything else is to court disaster. Don't expect the program to work right the first time, or the second. It might take one month or two months or more before the program runs completely the way it should.

Next, check the environment in which you expect the computer to be placed. Is it too dusty? If you see the dust, then yes. Is it too hot or cold? If you can be comfortable wearing a short-sleeve shirt, then the computer is probably OK. If you are hot, the computer probably is also. If you're cold, so is the computer. Both conditions must be under control.

Finally, are the power lines OK? If you have the slightest doubts, call in an expert from the local power company. If you need filtered power, get it. After all, why waste a $3000 investment because you didn't get a $300 filtered power supply?

If you have any questions, ask someone—it certainly will not hurt. With care, the computer system will probably outlast us all.

A Lesson to Learn

I think we will see more failures of this type in the future. The general public has too little knowledge of the frailties of microcomputers to appreciate the care with which they must be handled. Also, most small businessmen do not understand that micros are still in a semi-experimental stage. After all, two years ago most microcomputer companies were still far-fetched dreams.

Until the public is educated about what micros really are, we will see more and more micros fail because some businessmen have unrealistically high expectations and demands. ■

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Thoughts on the SWTP Computer System

Installment number five tells you how to put BASIC in ROM. Sound intriguing?

This is the fifth article in our series on the SWTP computer system and all the hardware and software accessories available for it. Judging by some of the reader mail, this month's topic is of great interest to many readers—how to put BASIC in ROM. Did I see your ears perk up?

Since the whole question of reworking someone else's software comes up pretty often, I'll describe the entire process from beginning to end. Maybe you'll get some ideas for your own next project.

Moving (Relocating) BASIC

Since it takes a little work to relocate BASIC, my first question was: "Which BASIC?" There are a lot of them available for the SWTP system. Here's just a partial list:

SWTP has made a whole batch of them over the years, all written by Robert Uiterwyk. There are several still current: 8K BASIC versions 2.0, 2.2 and 2.3 and disk BASIC version 3.0.

Technical Systems Consultants (Box 2574, W. Lafayette IN 47906) has a Micro BASIC Plus that runs in a 4K system and is the only one that comes with a complete source listing, which will make the job easier. They have just come out with a super-fast BASIC interpreter; it appears to be the fastest BASIC on any micro.

Computerware Software Services (830 First Street, Encinitas CA 92024) has four BASICs: a cassette file-handling BASIC, a disk file BASIC for sequential files for either the SWTP disk or the Smoke Signal Broadcasting disk, a random access disk file BASIC for the SSB disk and even a cassette BASIC already in either 2708 or 2716 EPROMs.

Percom Data Company (211 N. Kirby, Garland TX 75042) produces its own disk BASIC, which is also quite fast.

Hemenway Associates (151 Tremont Street, Boston MA 02111) produces a compiler for a BASIC-like language called STRUBAL.

GRT Corporation (1286 N. Lawrence Station Road, Sunnyvale CA 94086) sells a BASIC interpreter written by Microsoft, one of the pioneers in microcomputer BASICs.

```
               *
               *SUM - MEMORY CHECKSUM
               *
CC55 FE A002 SUM    LDX    $A002    GET STARTING ADDRESS
CC58 4F             CLR A
CC59 5F             CLR B
CC5A EB 00   SUMLP  ADD B  0,X      ADD TO CHECKSUM
CC5C 89 00          ADC A  #0       ALSO ADD CARRY TO SECOND BYTE
CC5E BC A004        CPX    $A004    LAST ADDRESS?
CC61 27 03          BEQ    SUMDON   YES
CC63 08             INX             NO, SO INCREMENT AND
CC64 20 F4          BRA    SUMLP
CC66 B7 A04F SUMDON STA A  CHEKSM   STORE SUM WHEN DONE
CC69 F7 A050        STA B  CHEKSM+1
CC6C 86 20          LDA A  #$20     GET SPACE
CC6E BD E1D1        JSR    OUTEEE   PRINT IT
CC71 CE A04F        LDX    #CHEKSM  POINT TO CHECKSUM
CC74 BD E0C8        JSR    OUT4HS
CC77 7E C821        JMP    SELECT
```

Program 1. Memory Checksum program.

Microware Systems Corp. (PO Box 954, Des Moines IA 50304) provides an A/BASIC compiler. (Computerware sells some patches to make it easier to use with SWTBUG or other monitors and to allow its use with the SSB disk.)

Another BASIC compiler, written by Software Dynamics ($325) is available from Smoke Signal Broadcasting (31336 Via Colinas, Westlake Village CA 91361).

Tom Pittman's Tiny BASIC (available from Itty Bitty Computers, PO Box 23189, San Jose CA 95153) is probably the least expensive and runs in just 3K.

I've probably missed a few BASICs, but that should put to rest the arguments of all the S-100 fans that there's no software available for anybody but them! Anyway, the first problem was to decide whose BASIC to EPROM. I chose SWTP 8K BASIC version 2.0 because it is inexpensive, most SWTP owners probably already have it, and it's versatile. Also, unlike some of the later SWTP BASICs, it's relatively bug-free.

The next step was to check whether it was PROMable. Does the code modify itself? Is the data mixed in with instructions in such a way that it would be difficult to move the whole thing into a ROM?

To be PROMable, a program must not change itself in any way while it runs, since ROM cannot be written into. Since this is hard to check without a listing, I used a trick which, while not foolproof, worked. I wrote a short program to go through all the BASIC code and simply add up all the bytes in the program. (I call it a checksum program, shown as Program 1. My checksum program is part of a monitor I have in a 2716 EPROM and turns out to be useful for making sure that programs are loaded correctly. In the program, locations A002 and A004 hold the first and last addresses to be checksummed; CHEKSM is a pair of locations for storing the sum, and SELECT is where the completed program returns.)

If a program doesn't change as it runs, the sum of all of its instructions will also not change. I ran the checksum program several times, before and after running various BASIC programs. Each time I received the same checksum, so I was pretty sure that BASIC stayed unchanged.

Since SWTP does not provide source listings for its software, the best I could do was to disassemble the machine-language code. This gives a listing with the assembly-language mnemonics but lacks all the meaningful labels and comments the original would have had.

There are several disassemblers available, ranging in price from no cost to about $30. A good one was written by Phil Hughes in the July 1977 issue of *Kilobaud* ("Introducing the Disassembler, p. 60); another appeared in *Dr. Dobb's Journal* in March 1977. SWTP has one available at low cost, and others are available from Computerware and Smoke Signal Broadcasting (they call it a Source Generator). I'll refer you to Phil Hughes' article for details on disassemblers.

I used the SWTP disassembler; three hours and about 70 pages later, I had a disassembled listing. I knew that BASIC took up memory locations 0100 through 1DB0. I also suspected that it used locations 00FF and below for data, since these can be reached with direct addressing instructions. I expected that the BASIC source program would take up locations 1DB1 and above.

The next step took about two hours—a careful study of the listing to identify those codes that were constants and those that were addresses. This is crucial, because when a program is moved to another area of memory, all its addresses will have to be changed, but constants have to stay the same. (It pays to be careful at the beginning, but this is one part of the job that involves a large part of intuition and guesswork.)

This revealed that, though most of the bytes in 0100 to 1DB0 were instructions, there were some areas that did not disassemble into any instructions that made sense. The SWTP disassembler prints out the ASCII equivalent for each byte that has one, and so a pattern started emerging. I recognized words such as TAB and SAVE. I eventually made a list of the data and the instructions.

0020-00FF. This area had flags, memory pointers, temporary storage locations and other changeable data. Since BASIC refers to this data mostly with direct addressing, it can't be moved. Hence, any relocated BASIC will still have to leave this data where it is.

0100-014D. Contains a whole batch of jump instructions that vector the cold-start and warm-start addresses and I/O operations for all ports. This can be moved, and all addresses have to be updated.

014E-0156. This data can be moved. But buried in this group are two addresses: 014E/F point to the beginning of the BASIC language text (which may or may not change, depending on where we put the source test) and 0150 holds 01, the number of the control port; this can be put into EPROM if you don't expect to change control ports, but must be moved into RAM if you do. I decided to leave it as 01, move it into EPROM and give up the capability of changing ports.

Locations 0151/2 point to the end of a lookup table, which will be relocated; hence this pointer will change.

Locations 0153 through 0156 hold the codes for the line delete, back space and other control characters. These should stay the same.

0157-015F. These are three jump instructions that don't seem to ever be used. I decided to play it safe and change their addresses when relocating.

0160-0314. This is a big data table, in which BASIC looks up the address of the routine that performs functions or commands. Each entry in the table consists of the ASCII code for the function or command word, followed by 00, followed by a two-byte address. When relocating this table, you can put everything into EPROM, but the addresses have to be updated.

0315-0346. Contains more data, that is, message strings such as READY and ERROR IN LINE. This, too, can be put in EPROM.

0347-0477. Program instructions.

0478-0484. The carriage-return string $0D, $0A, etc., followed by some rubouts.

0485-1C9C. Program instructions.

1C9D-1DB0. Constant data that seems to be used by some of the arithmetic routines.

This marks the end of the unchangeable part of BASIC.

Starting at 1DB1, BASIC stores its changeable data. 1DB1-1E2E appears to be a stack for processing arithmetic statements; 1E2F-1EAE is another data table; and the actual BASIC source text is stored from 1EAF up. None of this can be moved to EPROM.

Having looked through BASIC to find data and addresses, I next had to actually move the BASIC interpreter to some other area of memory and see whether it still worked. This is a good check to make sure all the addresses to be changed have been located.

Since my system contains 8K of memory from A000 to BFFF, I decided to move BASIC up there. The low part of that is used by my SWTBUG monitor, so I moved BASIC to start at A100. In other words, original location 0100 was moved to A100, 0101 went to A101, and so on.

I could have written a simple MOVE program to move all of BASIC up there without change and then used the monitor's memory change function to go through the moved program to change all addresses. But an easier way is to let the computer change addresses as well. The program to do just that is called a Relocator, which is available from Technical Systems Consultants ($8 with source listing, $23 with listing and cassette).

Listing 1 shows the dialogue between me and the Relocator. Initially, the Relocator asks where the original program is and where you'd like to move it. In my case, I wanted to move the area from 0100 through 1DB0 up to A100. As to the next two Relocator questions, I did want to fix address references but did not want to load from tape.

The next part asks for the addresses of data blocks. From the disassembled listing, I had identified four big blocks that were not instructions, so these became data blocks to the Relocator.

But some of these data blocks contained addresses; in the original assembly-language code, these addresses were probably done by FDB instructions, so the Relocator next asks whether there are any FDBs inside the data blocks which need changing to new addresses. Listing 1 shows

```
* TSC 6800 RELOCATOR *
PRESENT PROGRAM:
BEGIN ADDRESS? 0100
  END ADDRESS? 1DB0
      MOVE TO? A100
FIX REFERENCES? Y
LOAD FROM TAPE? N
DATA BLOCKS? Y


BEGIN ADDRESS? 014E
  END ADDRESS? 0156

BEGIN ADDRESS? 0160
  END ADDRESS? 0346

BEGIN ADDRESS? 0478
  END ADDRESS? 0484

BEGIN ADDRESS? 1C9D
  END ADDRESS? 1DB0


BEGIN ADDRESS? FFFF
ALTER RANGE? N
FIX FDB'S? Y

ADDRESS? 0151
ADDRESS? 0164
ADDRESS? 016B
ADDRESS? 0172
ADDRESS? 017A
ADDRESS? 0181
ADDRESS? 0188
ADDRESS? 018F
ADDRESS? 0196
ADDRESS? 019D
ADDRESS? 01A4
ADDRESS? 01AB
ADDRESS? 01B3
ADDRESS? 01BB
ADDRESS? 01C1
ADDRESS? 01C8
ADDRESS? 01CF
ADDRESS? 01D6
ADDRESS? 01DD
ADDRESS? 01E6
ADDRESS? 01F0
ADDRESS? 01F8
ADDRESS? 0200
ADDRESS? 0205
ADDRESS? 020D
ADDRESS? 0217
ADDRESS? 021D
ADDRESS? 0225
ADDRESS? 022D
ADDRESS? 0234
ADDRESS? 0239
ADDRESS? 0240
ADDRESS? 0248
ADDRESS? 024E
ADDRESS? 0256
ADDRESS? 025B
ADDRESS? 0262
ADDRESS? 0269
ADDRESS? 0273
ADDRESS? 0279
ADDRESS? 0281
ADDRESS? 028A
ADDRESS? 0290
ADDRESS? 0296
ADDRESS? 029C
ADDRESS? 02A3
ADDRESS? 02A9
ADDRESS? 02B3
ADDRESS? 02BE
ADDRESS? 02C6
ADDRESS? 02D0
ADDRESS? 02D7
ADDRESS? 02DB
ADDRESS? 02E1
ADDRESS? 02E8
ADDRESS? 02EF
ADDRESS? 02F6
ADDRESS? 02FF
ADDRESS? 0307
ADDRESS? 030C
ADDRESS? 0313
ADDRESS? FFFF


RELOCATION COMPLETED !!!
```

Listing 1. TSC Relocator output during relocation of SWTP 8K BASIC version 2.0.

what they are. An address of FFFF tells the Relocator that there are no more, so it completes relocation and types its message.

In the process of relocating the program, the Relocator changes several hundred addresses; Listing 1 doesn't really show all of them. With this and a disassembly listing, you could go ahead and move BASIC yourself, but it would be a massive job to make sure you didn't miss anything. So, after I moved BASIC, I wrote another program to compare the original BASIC with the relocated BASIC; Listing 2 is a complete list of all locations in the original program that require changing.

For instance, the first address printed in Listing 2 is 0101. If you look at location 0101 of the original BASIC, you see the byte 0B; it's part of the instruction 7E 0B91, which is a jump to location 0B91. After BASIC is moved from 0100 to A100, that instruction should be changed to 7E AB91. So, before the move, location 0101 had a 0B; after the move, location A101 will have an AB. Everything that started with 0 before will now start with A, and everything that started with 1 before now starts with B. With the aid of Listing 2 and a lot of patience, you can move BASIC to anywhere you want even without the TSC Relocator.

Although ultimately BASIC will go into EPROM, the move to A100 was done just for testing purposes. Only locations 0100 through 1DB0 were moved; everything else stayed where it was. This included the changeable data below 00FF and also left behind an area used for the input line buffer and some other variables in locations 1DB1-1E2E and in locations 1E2F through 1EAE. Also left behind was the area used for storing the BASIC source program, starting at 1EAF. These can't be moved into ROM and so have to stay.

But moving BASIC out of 0100-1DB0 leaves a big empty hole. The best thing to do is to slide all of the buffer areas and the source text down from 1DB1 and above to 0100. Hence, all references in the program to 1DB1 were changed to 0100; all references to 1E2F were changed to 0180; and all references to 1EAF were changed to 0200. This makes the BASIC source text start at 0200 and closes up that big empty space. Listing 3 shows exactly what changes have to be made.

The result was a BASIC up at A100 which seemed to work pretty well. At this point I had a brainstorm. Since the SWTP 8K board I used for memory at A000-BFFF had a Write Protect switch (which disables writing into it), I turned the switch to Protect after loading BASIC to make it act like ROM (reading is allowed, but writing is not). Everything died. After a while I realized that this also killed the monitor since it turned off all the RAM memory used by INEEE and OUTEEE. There was no chance to test the relocation this way. Relocating BASIC and making it work in RAM was the theoretical part; now came the practical part of actually moving it into EPROM.

As you can see by comparing Listings 1 and 2, relocating BASIC with the TSC Relocator (Listing 1) is a lot easier than going through BASIC and manually changing every affected address (Listing 2). But the Relocator can't relocate a program into EPROM. Now what? Before continuing, let's look at the EPROMs that we might use.

```
0101 0104 0107 010A 010D 0116 0119 011C 011F 0122 0125 0128 012B 012E 0131 0134 0137 013A 013D 0140 0143
0146 0149 014C 0151 0158 015B 015E 0164 016B 0172 017A 0181 0188 018F 0196 019D 01A4 01AB 01B3 01BB 01C1
01C8 01CF 01D6 01DD 01E6 01F0 01F8 0200 0205 020D 0217 021D 0225 022D 0234 0239 0240 0248 024E 0256 025B
0262 0269 0273 0279 0281 028A 0290 0296 029C 02A3 02A9 02B3 02BE 02C6 02D0 02D7 02DB 02E1 02E8 02EF 02F6
02FF 0307 030C 0313 03B3 03B8 03FA 03FD 0404 0407 040D 041B 0424 0429 042C 0445 044F 045C 0464 0471 04A8
04B7 04E7 0504 050A 050D 051E 0526 052C 0532 0537 053A 0542 0547 054E 055B 0574 0589 059A 059D 05A6 05D8
05DD 05E4 05F1 0607 0611 0620 0625 0682 068C 0699 06C0 06C7 06CB 06CE 06D8 06DC 06E7 06EA 06F8 0705 0712
071A 071D 0722 072C 0737 0743 074C 074F 0752 0759 075C 075F 0762 0767 0770 0778 077D 0787 078A 0790 079D
07A9 07B3 07BF 07C6 07D0 07D5 07D8 07E3 07E6 07F5 07F8 0806 0811 0814 0831 083F 0842 084F 0872 0876 0879
087E 0887 088A 089B 08AC 08C5 08FE 0901 0907 0912 093E 0948 0950 0953 0956 095A 095D 0960 0963 0968 096D
0970 0975 098A 098D 0990 09C4 09C7 09CA 09CD 09D4 09DB 09DE 09EC 09F1 09F4 09F7 09FA 0A03 0A09 0A13 0A1B
0A20 0A27 0A3C 0A3F 0A46 0A49 0A4C 0A55 0A5B 0A63 0A66 0A6C 0A6F 0A76 0A79 0A81 0A84 0ACB 0AD2 0AD7 0AE8
0B19 0B23 0B31 0B4B 0B50 0B6B 0B6F 0B72 0B88 0B95 0BA4 0BA7 0BB6 0BBB 0BC0 0BC3 0BC6 0BC9 0BCF 0BD5 0BD8
0BDD 0BE5 0BF5 0BF8 0C0B 0C0E 0C14 0C17 0C1A 0C20 0C23 0C26 0C5C 0C5F 0C62 0C65 0C6A 0C6F 0C74 0C7B 0C81
0C91 0CA6 0CAC 0CAF 0CB2 0CC8 0CCD 0CD0 0CD3 0CD6 0CD9 0CDC 0CDF 0CE7 0CEB 0CF6 0CF9 0D01 0D04 0D09 0D0C
0D0F 0D16 0D19 0D1D 0D2C 0D33 0D39 0D40 0D43 0D4B 0D64 0D6B 0D6E 0D75 0D86 0DD2 0E2F 0E45 0E52 0E61 0E64
0E67 0E6C 0E71 0E74 0E79 0E7C 0E93 0E96 0E9B 0EA0 0EA5 0EA8 0EB1 0EB6 0EBB 0EC7 0ED3 0EE7 0EEC 0EF4 0EFE
0F05 0F0A 0F16 0F21 0F24 0F27 0F2A 0F2F 0F32 0F37 0F3A 0F45 0F4E 0F91 0F9A 0F9F 0FA6 0FB0 0FBB 0FC3 0FCD
0FE2 0FE5 0FE8 0FF0 0FF6 0FFB 0FFE 100A 101D 1022 1025 103A 1047 104A 105E 1078 10A0 10CE 10D5 10D8 10E0
10E5 10F7 10FD 1104 110D 1122 1134 113D 114A 114F 1154 1160 117A 1188 1198 11A1 11A4 11A7 11AE 11B4 11BE
11C6 11D7 11DD 1203 1220 1232 1244 124D 1250 1255 1258 125B 1263 126D 1279 127C 128C 12B5 12D3 12DB 12E2
12F3 12F6 1301 132F 133F 1348 134B 134E 1355 1363 1370 1374 1377 1382 1385 1393 13A7 13AC 13BB 13BE 13CF
13D9 13DE 13E6 13F0 13F7 13FA 13FE 1409 140C 1424 1429 142C 142F 1434 1442 1447 144C 1456 145F 1471 1479
1483 148C 148F 14A3 14A6 14AB 14BC 14D4 14DC 14E5 14ED 14F6 14FB 1505 150A 1534 1537 1543 1554 155C 155F
1562 1565 1568 156F 1576 1579 1580 1583 158A 1591 1596 1599 15A0 15BB 15C0 15C5 15C8 15D5 15EA 15ED 15FC
1601 160E 1611 1617 161A 1621 1624 162D 1633 163A 164B 1650 165C 1664 1669 166E 168B 1694 1699 16A0 16CA
16DC 16DF 16E9 1718 171B 1723 1727 1731 173B 173E 1741 174D 1750 1758 1766 1772 1777 1781 1784 1787 178A
178D 1790 179F 17A2 17A8 17AE 17B4 17BA 17BF 17C2 17C6 17D4 17DF 17ED 17F2 1804 1814 181B 181E 1821 1824
1831 1836 183B 184D 1853 185A 185D 1863 186A 1873 187B 1881 1886 1893 189A 18A3 18A8 18B1 18DA 18E0 18E5
18EC 1903 1906 1915 1918 1924 1927 192C 1931 1937 193C 1942 194D 195A 196D 1972 1979 197E 1985 1998 199F
19B6 19C8 19CD 19D4 19DC 19EF 19F4 19FE 1A02 1A07 1A0A 1A0F 1A12 1A15 1A18 1A1D 1A20 1A23 1A2B 1A2E 1A33
1A36 1A39 1A3C 1A3F 1A42 1A45 1A48 1A4B 1A4E 1A51 1A54 1A57 1A5A 1A5D 1A64 1A67 1A6A 1A70 1A81 1A84 1A87
1A8F 1A95 1A9B 1AA7 1AAD 1AB0 1AB3 1AB7 1AC0 1AC7 1ACC 1ACF 1AD6 1AE3 1AED 1AF0 1AF5 1AF8 1AFB 1B05 1B08
1B0C 1B11 1B20 1B23 1B26 1B2C 1B2F 1B34 1B4C 1B4F 1B59 1B5C 1B64 1B67 1B71 1B76 1B79 1B7E 1B81 1B84 1B87
1B8C 1B8F 1B94 1B9A 1B9D 1BA0 1BA6 1BAB 1BB4 1BBA 1BC4 1BC7 1BCA 1BCD 1BD0 1BD3 1BD6 1BDB 1BDE 1BE4 1BE7
1BED 1BF1 1BF4 1BF7 1BFA 1BFD 1C00 1C03 1C09 1C0C 1C0F 1C14 1C17 1C1A 1C1D 1C20 1C23 1C26 1C2F 1C37 1C3A
1C3D 1C40 1C43 1C46 1C49 1C4C 1C4F 1C52 1C55 1C5C 1C68 1C6B 1C6E 1C71 1C74 1C77 1C7C 1C7F 1C87 1C8A 1C8D
1C90 1C98 1C9B
```

Listing 2. Locations that must be changed to relocate SWTP 8K BASIC Version 2.0.

Choosing the EPROMs

At present there are really only two reasonable choices for EPROMs: the old standby 2708 or the newer, and much more expensive, 2716.

The 2708 EPROM is a 1K × 8 chip that is selling for about $10 or so at the time of this writing; it will probably be slightly less expensive by the time you read this. It requires multiple power supply voltages of +12, +5 and −5 volts and is somewhat messy to program.

The newer 2716, on the other hand, is a 2K × 8 chip. There are two similar but not interchangeable versions of this IC. The Intel 2716 uses just a single +5 volt power supply and is now also produced by Mostek and others. It is also made by Texas Instruments under the number TMS2516.

But TI also makes a TMS2716, which is quite different—it uses the same power supplies as a 2708 and also requires a completely different programming sequence. It is not as popular, as you can see from the price. At the time of this writing, the TMS2716 has been at a fairly steady $30 or so for months, while the Intel 2716 has risen from $35 a few months ago to as high as $70 right now; I hope it will be back down by the time you read this.

Since the 2716 holds twice as much, but costs from four times to as much as seven times more, it seems that the 2708 is a better buy. From the IC point of view that's true, but the price of 2708 programmers and boards to use them is so much higher that even with their higher IC cost, the 2716 may be more inexpensive in the long run.

The new SWTP MP-A2 CPU board has room for four 2716s, for a total of 8K of EPROM. Owners of newer SWTP systems already have this board, and owners of older systems can update from the older CPU board to the newer one for about $50 if their old CPU board uses sockets; they can just move most of the ICs to the new board. So using the 2716 is a cinch.

Programming the 2716 is also a cinch. SWTP makes the MP-R 2716 Programmer for $45. It consists of a printed circuit board that plugs into one of the I/O ports and contains a few ICs along with a socket for one 2716. This is a "zero insertion force" socket, which has a short handle on the side. When the handle is moved to the unlocked position, the socket opens up to receive a 2716 EPROM. When the handle is locked, the socket grabs the pins of the 2716 and holds it tight.

Included with the MP-R is a cassette with a program that does all the programming for you. This program uses a block of memory starting from location 0800 as a data buffer for the data to be programmed into the EPROM, but any other area of memory can be used. The program can check that a 2716 is really fully erased, can read the contents of a 2716 into the buffer at 0800, can read a program from cassette into that buffer (even if it is intended for somewhere else), can perform some editing on it, can write the contents of the memory buffer into the EPROM and can compare the contents of the EPROM with the contents of the memory buffer to verify that the programming was done right. Thus the program can be used to program an EPROM from cassette and can also be used to read one EPROM and copy it into another.

At this price, the SWTP programmer is a bargain; no other programmer even approaches it in value. The new CPU board also makes the job of using 2716s easy. But this is offset by the 2716's high cost. At today's prices of $60-$70 each, a set of four to hold BASIC would cost about $250. That's a bit steep. (Although if the price goes back to the $35 range by the time this article appears, the price of $150 or less for 8K of EPROM will be more in line with the price of RAM, and may make the PROMing of BASIC very worthwhile.)

CHANGE LOCATIONS	FROM	TO
014E/F	1EAF	0200
0C34/5	1E2F	0180
0E36/7	1DB1	0100
1515/6	1E2F	0180
153C/D	1EAF	0200
15DE/F	1E2F	0180
15E5/6	1E2F	0180

Listing 3. These changes move the BASIC source text to 0200. With 16K of RAM, this will leave almost 15½K for source text.

Because of its lower price, the 2708 EPROM is also popular. Although SWTP doesn't make any 2708 boards or programmers, there are several compatible ones available. Let's look at a couple.

Micro Works 2708 EPROM Boards

Micro Works (PO Box 1110, Del Mar CA 92014) makes both an EPROM board ($120) and a 2708 programmer ($100). Their PSB-08 EPROM board is quite interesting. It is a CPU-sized board that plugs into the main SWTP bus. It has sockets for eight 2708s, for a total of 8K. A DIP switch is used for selecting the address for this 8K memory block; the 8K block can start at 0000, 2000, 4000 or any 8K block up to E000.

When PROMing BASIC, a logical place to put the 8K of EPROM is in addresses C000-DFFF, which are otherwise not used. The board can also be used at E000-FFFF for custom monitors to replace MIKBUG or SWTBUG. (They sell Smoke Signal Broadcasting's SMARTBUG monitor on a 2708 EPROM for use with their board.)

2708 EPROMs require a +12 volt supply, among others. This board uses that voltage directly, without regulation, on the assumption that it is fairly marginal in the first place. If you have upped it (using some of the tricks we discussed in the first article in this series in the March 1979 issue of *Microcomputing*) to above 12 volts, Micro Works has a 12 volt regulator that can be installed on the board. It would be a good idea

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to add filtering to the +12 volt supply.

The SWTP CPU board has a 6810 128 byte RAM that is addressed at A000 through A07F and is used by the monitor. In case you need more space, the Micro Works EPROM board has a 1K byte RAM consisting of eight 21L02 ICs. With a DIP switch, this RAM can be addressed at any 8K boundary, such as 0000, 2000, 4000, up through E000. It can replace the 6810 on the CPU board when addressed at A000.

But the most interesting thing about the board is its circuitry for relocating the I/O. As you know, the SWTP system has its I/O ports located at addresses 8000 through 801F. This leaves room for 32K of memory below and 12K or more memory above. But since the I/O is smack in the middle of this, most SWTP systems stop at 32K; those that have more seldom use the additional memory, since few stock programs use that area.

The Micro Works EPROM board has a simple circuit that allows moving the I/O port addresses from 8000 up to F800. This requires a small change on the motherboard and allows 56K of RAM (up to address DFFF) to be installed in the system, along with 7K of EPROM (1K is replaced by the I/O ports at F800). What it essentially does is to replace part of the address decoding circuitry on the motherboard with the decoder on the EPROM board.

When you do this, you also have to change some software. The monitor (whether it's MIKBUG, SWTBUG or whatever) will have to be modified to change its I/O addressing. Likewise, BASIC and the Cores editor/assembler also access the I/O ports directly (rather than going through the monitor) when they want to check for a control-C character, and so they have to be modified. Micro Works gives some of those changes in their manual.

The Micro Works model B-08 2708 Programmer is a companion unit ($100). Except for the price, it is in many ways similar to the SWTP 2716 programmer. The B-08 plugs into port 4 of the I/O bus and has a zero insertion force socket for a 2708. The manual lists a program that uses a memory buffer area from 0000 to 03FF for holding the data to be written to the 2708. The program can test whether an EPROM has been fully erased, read the contents of a 2708 into the memory buffer area, initialize that buffer, read a cassette tape originally intended for another area of memory into that buffer, move the contents of another section of memory into that buffer, write the buffer into the 2708 and verify that the 2708 contents match the contents of the buffer.

In addition to listing the programming program in the manual, Micro Works also makes it available separately on either a Kansas City cassette starting at address 1000 ($10) or on a 2708 EPROM starting at either address C000 or FC00 ($30); the latter also contains the four reset and interrupt vectors that the 6800 needs up at addresses FFF8 through FFFF.

Both Micro Works boards appear to be well designed and built; the only fault I could find with them was that the program in the B-08 manual is the EPROM version addressed at C000, and hence not directly usable by the typical purchaser. If you don't want to buy their extra cost cassette or EPROM version of the program, you first have to reassemble their listing to place it at a more reasonable address.

The Smoke Signal Broadcasting 2708 EPROM Boards

The SSB model P-38 EPROM Board ($129) also has sockets for eight 2708s. A DIP switch on the board allows this 8K block of memory to be addressed at 0000, 2000, 4000 or any 8K boundary up through E000. When used at E000, it can replace your standard 6810 monitor on the CPU board. SSB produces their own monitor, called SMARTBUG, for this purpose.

When used to replace a standard monitor, this board has some interesting options. One

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option is to select one of the 2708s to be addressed at two addresses—E000 through E3FF and also FC00 through FFFF. You can then use the same 2708 for both the monitor at E000 and also for the reset and interrupt vectors at FFF8-FFFF. If you don't want to do that, you can use the socket on the board to hold your 6810 monitor (MIKBUG or SWTBUG).

There is an advantage in having it on the EPROM board rather than just leaving it on your CPU board. When the 6810 is plugged into the CPU board, it is not fully decoded. Each location of the 1K monitor actually has eight addresses, so that it uses up the full 8K block from E000 through FFFF. But when it is plugged into the EPROM board, it is fully decoded and only uses up the addresses from E000 through E3FF and FC00 through FFFF. Hence, the remaining space—from E400 through FBFF—can be used for 2708 EPROMs.

The POP-1 2708 Programmer ($129) is a separate box that plugs into a modified EPROM card (the P-38-1 at $174, which also contains an interface for the Oliver paper tape reader) to program 2708s. It attaches to the P-38-1 with a ribbon cable and has its own power supply for generating the 26 volts that the 2708 needs for programming. It includes a cassette with the required software to program.

As with any system containing 2708 EPROMs, the +12 volt computer supply has to have the right voltage and has to be free of ripple. SSB makes a PS-1 Power Supply Kit ($25) for this purpose to increase the ±12 volt supply outputs to 16 volts, so that an on-board regulator can then properly regulate this down to a clean 12 volts. You may want to read the discussion of power supply fixes in the first of these articles, back in the March 1979 issue of *Microcomputing*.

Other EPROM Boards

Actually, building an EPROM board with today's ICs is not difficult. You could build your own (using the circuitry on the

```
* TSC 6800 RELOCATOR *
PRESENT PROGRAM:
BEGIN ADDRESS? 0100
  END ADDRESS? 1DB0
     STORE IN? 4100
EPROM ADDRESS? C100
FIX REFERENCES? Y
LOAD FROM TAPE? N
DATA BLOCKS? Y

BEGIN ADDRESS?
```

Listing 4. The TSC Relocator as patched asks for an address to put the BASIC and also for an EPROM address to relocate to.

SWTP MP-A2 board as a model, for instance).

There are also several other ways. JPC Products Co., PO Box 5615, Albuquerque NM 87185, is offering a separate 2716 EPROM board that holds 8K worth of EPROM and sells for around $50.

Two EPROM boards are also available from Gimix, Inc. (1337 W. 37th Place, Chicago IL 60609). One is a 4K PROM and programmer board, which holds four 2708s. It can be used as a regular EPROM board, but it can also program any or all of the four. It has a DIP switch for addressing to 0000, 1000, 2000 or any 4K boundary. The other board is an 8K board with 2708s; it can be addressed to any 8K boundary from 0000 to E000 with a DIP switch.

Another EPROM board is available from Kendra Co., Box 1575, Independence MO 64055 ($25). This one holds either two 2708s for 2K or two 2716s for 4K and is designed as an adapter board that plugs into the 6810 socket on the MP-A CPU board, instead of the monitor that normally sits there. Obviously, none of the 4K boards is usable for PROMing BASIC, which needs slightly over 7K. But the 8K boards will do quite nicely.

A bare 2708 EPROM board, which holds up to 16K, is available for $27.50 from Walter Wimberly, 2914 Sunrise Dr., Orlando FL 32803. The most inexpensive way to program 2708s is to modify the SWTP 2716 Programmer. More on that in a future installment.

PROMing BASIC

So let's return to the problem of PROMing BASIC. Before I started on this review of available EPROM boards and programmers, I left you with information on how to relocate BASIC anywhere else in memory. Now let's finish talking about how to get it into EPROM. Since they are the easiest to use, let's talk in terms of using either the SWTP 2716 programmer or the Micro Works 2708 programmer.

Both of these require that you put the program to be PROMed into a memory buffer area. The Micro Works uses the memory from 0000 to 03FF for a 1K buffer, so you'd have to split BASIC into eight 1K pieces and program one at a time. The memory buffer for the SWTP programmer is normally at 0800 but can be moved anywhere in memory. You can program just one 2K segment or you can store all 7K of BASIC in memory at once and program the 2716s sequentially.

In any case, we now have to move BASIC from wherever it is in memory to the buffer area the programmer needs and also change all the addresses to the ones needed. For instance, if you're going to put BASIC into 2716 EPROMs on the MP-A2 CPU card, you need to address everything in the range of C000-DFFF. You could start BASIC at C000 and have it go to DAD0, but it is probably easier to have it go from C100-DBD0 so as to make it more like the original 0100-1DB0 version. This can be done in two ways—first change the address and then move or else first move and then change addresses.

BASIC can be physically moved from one place to another fairly easily. You can write it on tape and then use the software that comes with the programmer to read the tape back into the buffer, or else you can write a program to move it from one place in memory into another. The TSC Relocator can also move memory blocks without changing them.

Changing the addresses is a bit harder. The TSC Relocator example at the beginning of this article showed how the Relocator moves and relocates at the same time. It moves and relocates into the same place in memory. But in this case we don't want to do that—we have to move to one place in memory but relocate the addresses to another place. In this case, we want to relocate the addresses to C000, but we need it moved into RAM so it can be burned into the EPROM by a programmer.

Since the standard TSC Relocator can't do that, we have to patch it as shown in Program 2. This allows us to relocate the

```
OBCB 7F 0040    @      -  CLR     0040     0001  NAM SMOKEGEN
OBCE BD 044C    L         JSR     044C     0002  ORG $OBCB
OBD1 CE 00Bv              LDX   # 00B0     0003 E1 EQU $0040
OBD4 BD 0ABF              JSR     0ABF     0004 E2 EQU $044C
OBD7 BD 063A    :         JSR     063A     0005 E3 EQU $00B0
OBDA 25 05     %          BCS   > OBE1     0006 E4 EQU $0ABF
OBDC BD 0D6A              JSR     0D6A     0007 E5 EQU $063A
OBDF 20 EA                BRA   > OBCB     0008 E6 EQU $0D6A
OBE1 4D         M      -  TST A            0009 E7 EQU $0B27
OBE2 27 E7     '          BEQ   > OBCB     0010 L2 CLR E1
OBE4 BD 0B27    '         JSR     0B27     0011  JSR E2
                                           0012  LDX #E3
                                           0013  JSR E4
                                           0014  JSR E5
                                           0015  BCS L1
                                           0016  JSR E6
                                           0017  BRA L2
                                           0018 L1 TSTA
                                           0019  BEQ L2
                                           0020  JSR E7
                                           0021  END

                                           013E BYTES GENERATED
                                           0007 EXTERNAL LABELS
                                           0002 LOCAL LABELS
                                           0000 VARIABLES
                                           0000 DATA LABELS
```

Listing 5. The same portion of BASIC (A) disassembled by the SWTP Disassembler and (B) disassembled by the Smoke Signal Broadcasting Source Generator in Cores format.

addresses from one area of memory (such as EPROM at C100) but actually physically move the program somewhere else (such as RAM at 4100). Listing 4 shows the new dialog with the Relocator to do this. (The idea behind Listing 4 was to move BASIC to start at 4100 while relocating it to get it out of the way, then load in the software for the PROM programmer and then use the TSC Relocator again to move BASIC from 4100 back down to the buffer area for the programmer.)

```
                       NAM    RELOC
                       OPT    O,NOP,NOG
                *************************************
                *PATCHES FOR TSC RELOCATOR
                *TO ALLOW RELOCATION AND STORING
                *IN DIFFERENT PLACES SO PROGRAM
                *CAN BE RELOCATED FOR EPROM BUT
                *STORED IN RAM
                *P. STARK 12/20/78
                ************************************
                *
                *EQUATES FOR TSC RELOCATOR LOCATIONS
                *THIS ASSUMES RELOCATOR HAS BEEN MOVED TO $3200
      3200      LOC    EQU    $3200
                *CHANGE TEXT OF MESSAGE ASKING FOR NEW ADDRESS
360A                   ORG    LOC+$040A
360A 20         STORAD FCC    '     STORE IN? '
                *RELOCATOR ADDRESSES
      3268      PINADD EQU    LOC+$0068  INPUT NUMBER TO X REGISTER
      363E      FIXRFS EQU    LOC+$043E  'FIX REFERENCES?'
      3213      OLDPTR EQU    LOC+$0013
      321D      OFFSTL EQU    LOC+$001D  LEFT HALF OFFSET FOR MOD'N
      321E      OFFSTR EQU    LOC+$001E  RIGHT HALF OFFSET
                *
                *PATCH FOR GETTING EPROM ADDRESS
3380                   ORG    LOC+$180
3380 7E 31D0           JMP    PATCH1
31D0                   ORG    LOC-$0030
31D0 CE 319E PATCH1 LDX    #PROMAD  ASK FOR EPROM ADDRESS
31D3 BD 3268           JSR    PINADD   INPUT ADDRESS
31D6 FF 31AE           STX    XTEMP
31D9 B6 31AF           LDA A  XTEMP+1  CALC RIGHT HALF
31DC B0 3214           SUB A  OLDPTR+1
31DF B7 31B1           STA A  OFFST2+1
31E2 B6 31AE           LDA A  XTEMP    CALC LEFT HALF
31E5 B2 3213           SBC A  OLDPTR
31E8 B7 31B0           STA A  OFFST2
31EB CE 363E           LDX    #FIXRFS  ASK TO FIX REFERENCES?
31EE 7E 3383           JMP    LOC+$183 RETURN TO TSC
                *
                *PATCH TO CHANGE OFFSET FOR 3-BYTE INSTRUCTIONS
34FD                   ORG    LOC+$02FD
34FD BB 31B1           ADD A  OFFST2+1
3503                   ORG    LOC+$0303
3503 B9 31B0           ADC A  OFFST2
                *
                *PATCH TO ADD ONE OFFSET WHEN
                *FIXING FDB'S, BUT USE THE OTHER
                *FOR ACTUAL RELOCATION
3574                   ORG    LOC+$374
3574 8D 2F      DONE1  BSR    ADDOF2
35A2                   ORG    LOC+$03A2
35A2 7E 3180 ADDOFF JMP    ADD1
35A5 7E 318F ADDOF2 JMP    ADD2
3180                   ORG    LOC-$0080
                *ADD OFFSET FOR ACTUAL RAM LOCATION
3180 A6 01      ADD1   LDA A  1,X
3182 BB 321E           ADD A  OFFSTR
3185 A7 01             STA A  1,X      RIGHT HALF
3187 A6 00             LDA A  0,X
3189 B9 321D           ADC A  OFFSTL
318C A7 00             STA A  0,X      LEFT HALF
318E 39                RTS
                *ADD OFFSET FOR PROM LOCATION
318F A6 01      ADD2   LDA A  1,X
3191 BB 31B1           ADD A  OFFST2+1
3194 A7 01             STA A  1,X      RIGHT HALF
3196 A6 00             LDA A  0,X
3198 B9 31B0           ADC A  OFFST2
319B A7 00             STA A  0,X      LEFT HALF
319D 39                RTS
                *
                *DATA
319E 45         PROMAD FCC    'EPROM ADDRESS? '
31AD 04                FCB    $04
31AE 0002       XTEMP  RMB    2
31B0 0002       OFFST2 RMB    2
                       END
```

Program 2. Patches to the TSC Relocator to allow relocation for EPROM but storage in RAM.

Disassembly/Reassembly

There is another way to relocate BASIC—use a disassembler to change BASIC back into assembly code, change the ORG statement to ORG $C100 and then reassemble. Although I haven't tried it, I think that BASIC is too long for its assembly language to fit into even a 32K system. The assembly language could be broken up into pieces and assembled separately, but this would make it rather difficult to pass labels back and forth between them. (Disassembly/reassembly of such a long program would be easy if you had a disk, but then you'd probably not be too interested in PROMing BASIC in the first place.)

Though there are a number of disassemblers available, most of them output their disassembled code with addresses instead of operands. But we need one that will make up labels so that the assembly code is in the right format to be accepted by an assembler.

There are two that I know of: The SCG-68D Source Code Generator by the Amador Group (PO Box 2032, Menlo Park CA 94025) costs $30 on diskette and runs on the SWTP floppy disk system. The SG-1 from Smoke Signal Broadcasting costs $12 on cassette, or $31 on a diskette for the SSB floppy disk. Percom Data Company has some patches to make the SSB generator usable on its disk as well.

Unlike a disassembler, which lists actual addresses for operands, a source generator makes up labels for them. Labels for items within the program are given as part of the assembly code; labels for items outside the program are given as EQU pseudo-ops. Memory areas used for data can be specified to the generator, and it will then try to translate them into FCB or FCC instructions; it will also do so when unrecognizable instructions are found. A good source generator should be smart enough to recognize a block of ASCII text and translate it into FCC instructions, for instance.

Listing 5 shows the difference in output between that of the SWTP disassembler and the SSB Source Generator when we disassemble the same part of 8K BASIC. The disassembler is what you need when studying a strange program, but the source generator is needed if you are going to reassemble. You can see why from the listing.

The Amador source generator has to work with the SWTP floppy disk and is the only one I know of that does right now. Its output is compatible with the TSC Editor and Assembler, which runs under the Flex operating system, so that you can then edit the assembly code before reassembling.

The SSB source generator will work with either cassette, the SSB floppy disk or (with the Percom patches) the Percom floppy disk. It is quite versatile; you can specify whether you want the output printed on the terminal, printed on a PR-40 printer on port 7, stored on an SSB disk or output to cassette.

Disk or cassette output can be in either Cores editor-assembler format or in SSB Editor/Assembler format. (The SSB SE-1 Editor and the SA-1 Assembler are actually modified versions of the TSC Editor and Assembler, so the source generator output can be edited or assembled by the TSC software as well.)

But disassembling and then reassembling BASIC is really not too practical a method of relocating. As I mentioned before, the assembly code for BASIC is probably too long to fit into even very large systems, and so the amount of work to do the reassembly in pieces would be very large unless you had a disk system. In that case you probably don't need BASIC in EPROM; not only that, but with a disk system you want a BASIC other than SWTP 8K BASIC version 2.0, since there are others that have disk commands for storing programs and using disk files. Since most of these BASICs are over 8K in size, they will require additional EPROM boards to hold them. ■

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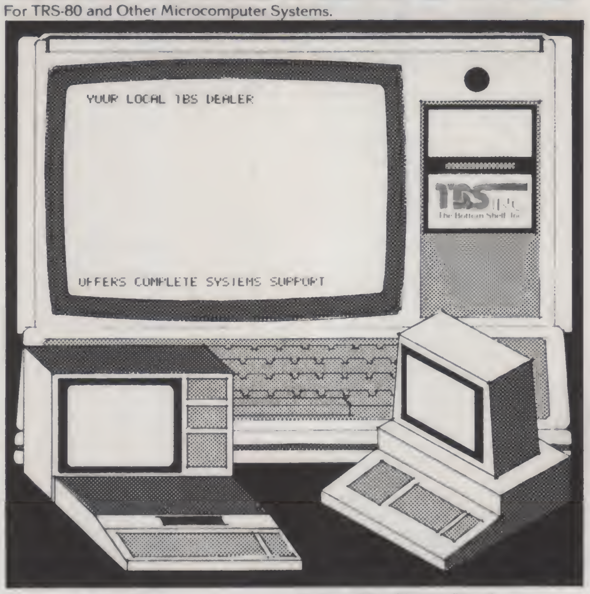

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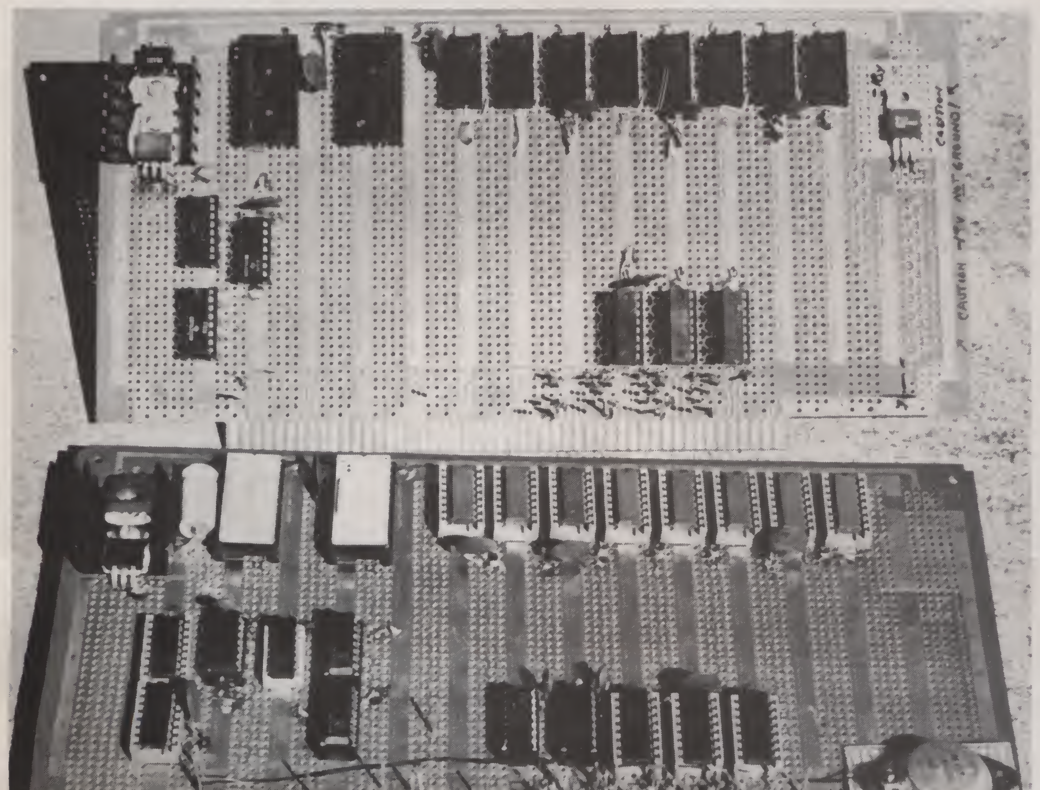
2708 EPROM for the S-100

Out of frustration, the author of this article designed and built this versatile EPROM board. The result of all that happened is that his frustration is your gain.

There have been many times when I have wanted the capability of having my Altair ready to run without having to key in the bootstrap after turning on the switch. The routine of loading in a bootstrap every time I had to power up the machine was getting a little old after a year of tinkering. Besides, whenever anyone came over to visit or to see the Altair (you've got a *what* at home?), it took a little of the zing out to have to sit down and key in a short program from the front panel. The way that *my* luck would run usually meant I had to key in the bootstrap twice since I'd make some small mistake loading the first one while trying to explain what I was doing!

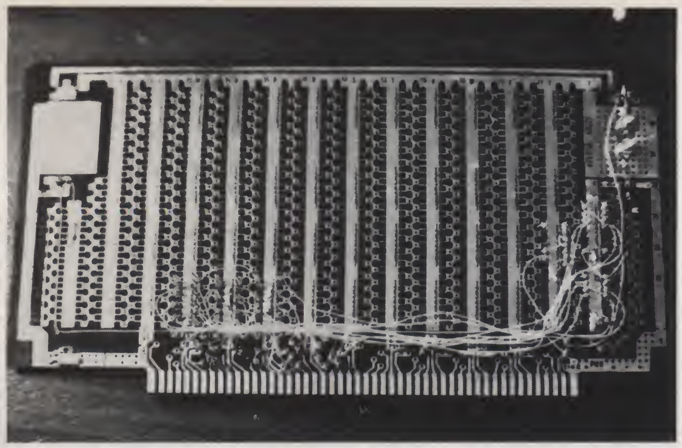


Completed boards #1 and #2 (#1 is on the bottom). Extra ICs on board #1 are for extra functions not discussed or used on board #2. Board #1 uses a different type of negative regulator, which is mounted on the lower right of board. Note that the word caution is written on board #2 around the negative regulator. Not discussed was the use of bypass capacitors. Rule of thumb is to use one (.01 or .1 uF) for each three ICs present and place them close to the ICs.

I had a good operating system in CUTER, from Processor Technology. I was satisfied with it, but it required 3K RAM (or 2K ROM and 1K RAM immediately above the ROM). Loading CUTER into RAM was no problem as a short (41-step) bootstrap would load in a larger relocating loader that automatically loaded CUTER.

But there were two problems with that sequence. First, it required 3K of RAM, and, second, a "runaway" program (that is how most of mine work the first 10 or 15 times!) would, 99.9 percent of the time, destroy the CUTER routines, along with the errant program itself. There is *nothing* that gets older than having to repeatedly reload the bootstrap, then CUTER, then the problem program, then test it . . . have it eat the whole works again!

So there had to be an easier solution. Of course! Put the whole works into EPROMs!



Wiring side of board #2 after addressing and buffer sections have been assembled according to the directions in the text.

Quick, I had to find the latest issue of *Kilobaud* and find someone who made a board that would take 2708s and had 1K of RAM aboard.

What . . . *nothing*? All that was available at the time was one board that used 1702As for the EPROM and one other that did use 2708s but didn't allow for placing of the 1K of RAM just above 2K of the ROM. Well, I now had to look at doing something else.

I thought about modifying one of my RAM boards so that the 2K region that CUTER was in could be protected after loading, but I decided against this because I did not want to make a unique modification to one of my RAM boards. Besides, it still didn't solve the problem of having to key in the bootstrap every time the computer was turned on.

I discovered that Processor Technology was marketing their General Purpose Memory Board, which would be exactly what I wanted! In fact, it would hold 10K of 2708s and 1K of RAM. Perfect! Not so fast, though. At the time I wanted it they were still months away from delivery and could only say, "Next month . . . maybe." I just couldn't stand the wait and was going to have to build one.

As it turned out, that was, and still is, an excellent choice . . . I saved about $55 over the cost of the PTCo GPM. There are now several boards available as kits that will allow intermixing of RAM and EPROM, so you aren't forced into this decision the way I was. However, I think you won't regret making the decision to build one by following along with this article. Keep in mind that although the construction steps are laid out for building a mixture of EPROM and RAM, you can configure your board any way you want. With these objectives in mind, let's get started building your board!

Construction

I have built two of these boards, and both worked on initial power-up. They were built on Vector 8800V boards using

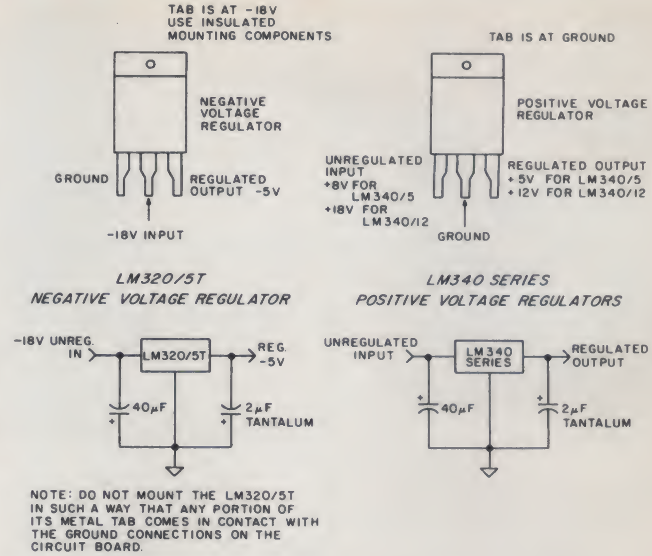
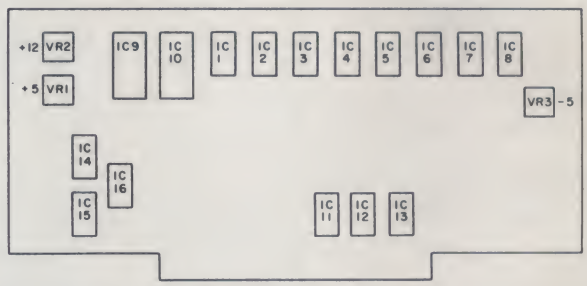


Fig. 1. Schematics of positive and negative voltage regulators.



IC	PART NUMBER	GND	+5	+12	-5
2102	IC1-8	9	10	–	–
2708	IC9-10	12	24	19	21
8097	IC11-13	8	16	–	–
74LS139	IC14-15	8	16	–	–
74LS00	IC16	7	14	–	–

Fig. 2. Layout of prototype board using 2K EPROM and 1K RAM.

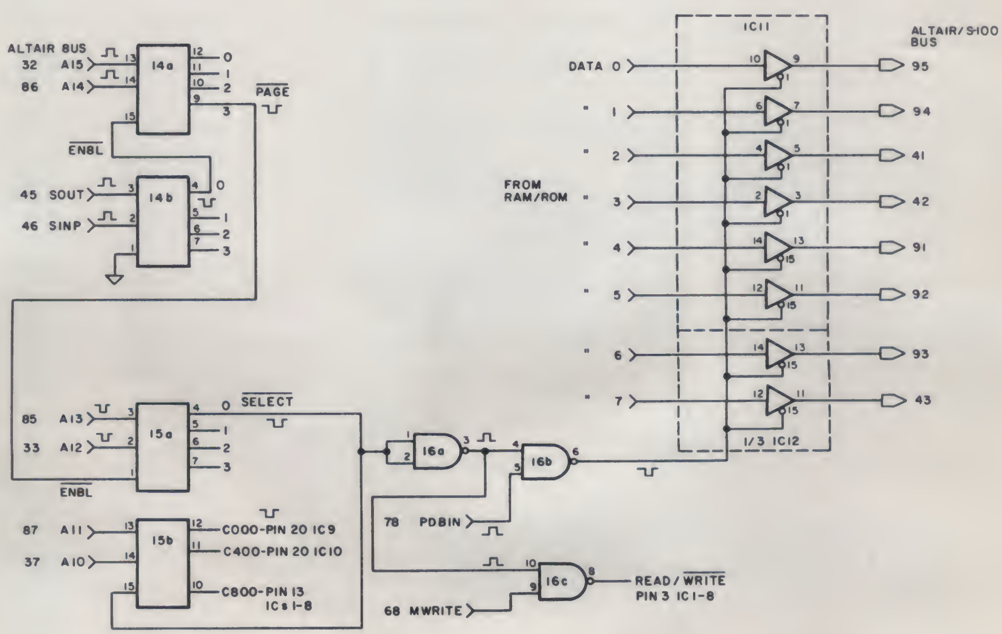


Fig. 3. Addressing schematic for use with prototype board (from Kilobaud *No. 1, p. 41).*

2102 RAMs		2708 ROMs		74367s	
Pin No.		Pin No.		Pin No.	
8	(All)	8	(All)	9	IC13
4	"	7	"	7	IC13
5	"	6	"	5	IC13
6	"	5	"	3	IC13
7	"	4	"	13	IC13
2	"	3	"	11	IC13
1	"	2	"	9	IC12
16	"	1	"	7	IC12
15	"	22	"	5	IC12
14	"	23	"	3	IC12
12	IC1	9	IC9&10	10	IC11
12	IC2	10	IC9&10	6	IC11
12	IC3	11	IC9&10	4	IC11
12	IC4	13	IC9&10	2	IC11
12	IC5	14	IC9&10	14	IC11
12	IC6	15	IC9&10	12	IC11
12	IC7	16	IC9&10	14	IC12
12	IC8	17	IC9&10	12	IC12

Table 1. Interconnection table for memory and drivers. Example: Pin 8 of all *2102s connects to pin 8 of* all *2708s and to pin 9 of IC 13.*

the Vector Slit 'N Wrap wiring tool. I really can't imagine wiring this project in any other manner, but any method of construction (point-to-point or wiring pencil, for example) is completely acceptable.

Step 1. Install wire-wrap pins on bus pad connectors for A0-A15, DI0-DI7, DO0-DO7, SINP, SOUT, PDBIN and MWRITE and solder them in place with a low-wattage iron. If these pins are not soldered, intermittent connections to the bus will result.

Step 2. Install +5, +12 and −5 volt voltage regulators (see Fig. 1). Check them out by removing all boards from your computer (just in case!) and

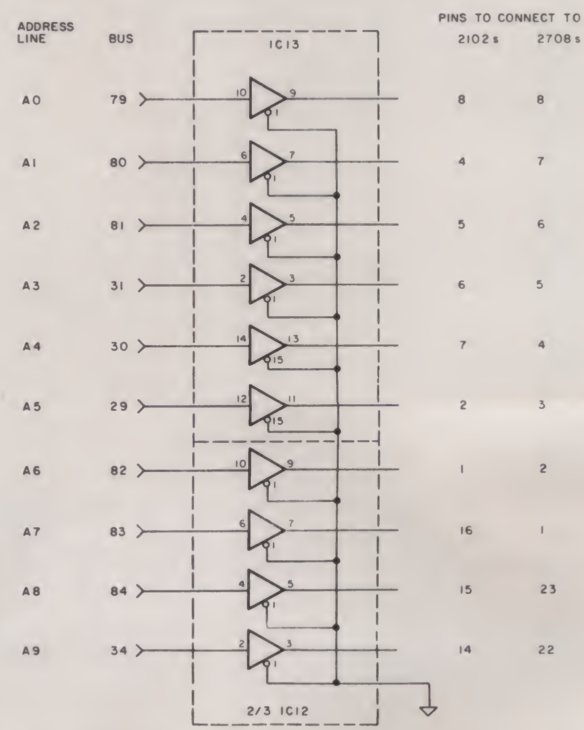


Fig. 4. Address bus drivers. Note that connections shown for 2102 and 2708 ICs are for all *ICs of that type installed.*

Altair/S-100 Bus	Pin/IC Number
36	11 IC1
35	11 IC2
88	11 IC3
89	11 IC4
38	11 IC5
39	11 IC6
40	11 IC7
90	11 IC8
79	10 IC13
80	6 IC13
81	4 IC13
31	2 IC13
30	14 IC13
29	12 IC13
82	10 IC12
83	6 IC12
84	4 IC12
34	2 IC12
95	9 IC11
94	7 IC11
41	5 IC11
42	3 IC11
91	13 IC11
92	11 IC11
93	13 IC12
43	11 IC12

Table 2. Altair/S-100 bus connections to memory and driver ICs.

measuring the output voltages. *Remember: Power off before removing or replacing any boards!* Now install all IC sockets and connect power and ground to appropriate pins (Fig. 2). *Double-check these!*

Step 3. Install two 74LS139s and one 74LS00 as in Fig. 3. Verify operation by examining C000 (hex) to ensure correct logic levels.

Step 4. Install three 74367 address/data buffers. Ensure appropriate enable lines function by examining different addresses (Figs. 3 and 4).

Step 5. Position eight 16-pin sockets and two 24-pin sockets. One address bit at a time, using your wire-wrap tool, daisy-chain that one bit to all memory ICs. Go slow and *double-check*! (This will be a *major* source of errors if hurried!). After all bits are wired, install in the computer and use a VOM (simple multimeter) to check proper logic at the *correct* pin of *each* socket for *each* address bit. Don't install any memory chips yet! (Tables 1 and 2 list IC interconnections for memory.)

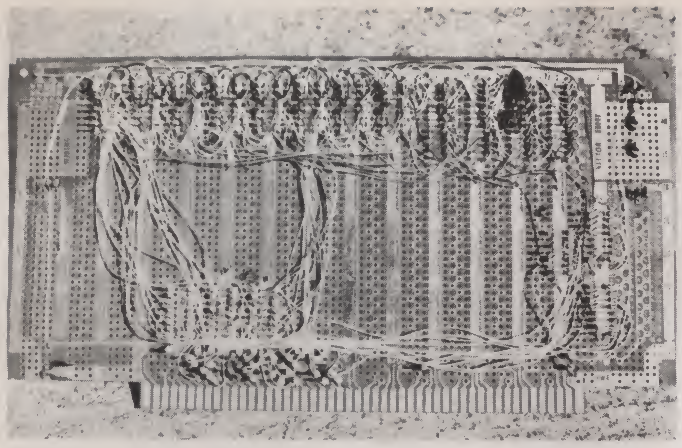
Step 6. Wire data-in (DI) lines to RAM chips (*not* the two 24-pin ROM sockets) using the same technique as in step 5. Verify that DI0-DI7 are on the correct pins by examining C800 (hex) and deposit one bit at a time, 0 through 7, while verifying (see Fig. 5).

Step 7. Wire data-out (DO) to RAM *and* ROM chips the same way as in step 6.

Step 8. Install *one* 21L02 RAM in one of the sockets (start with bit 0). Attempt to deposit a 0 to it. If successful (you should be!), repeat with all eight RAM positions. If unsuccessful, check the following: (a) +5 and ground are connected to RAM; (b) enable line connected to RAM from 74LS139; (c) READ/WRITE logic connected to RAM; (d) data out buffers functional.

Step 9. Remove RAM. Load one ROM. Power up and single-step through. If D0-D7 all indicate correctly, you're just about done. If not, then check the following: (a) enable logic to the 2708s from the 74LS139; (b) ROM programmed; (c) double-check power supply +5, +12, −5 to proper pins.

Step 10. Power down and



Completed board #2 (wiring side). It's not as hard or complicated as it looks as long as you go slowly and step-by-step as listed in the instructions.

carefully place all components on the board. Power back up and enjoy!

Operation

I must thank Bill Godbout for the address selection circuit; it's copied from his Econoram Board as described on page 41 of *Kilobaud* No. 1.

If IC14b SINP and SOUT lines are low, then the computer must be looking at memory somewhere or another so pin 4 will be low, which, in turn, will enable IC14a. This half of the 74LS139 functions as a decoder, and one of the four output pins will be low depending on the binary count of pins 13 and 14 (A14 and A15 from the bus).

IC15 functions in exactly the same manner. Part a will enable part b, depending on which pin is used for the $\overline{\text{SELECT}}$ line (see Table 3 for possible combinations).

Once the address logic decides that the computer wants access to this block of memory, the 74LS00 (IC16) decides if a read or write operation is to be performed. If PDBIN is high, then a low is generated on pin 6 to enable the data out buffers that gate the data from the RAMs or ROMs onto the bus. The READ/$\overline{\text{WRITE}}$ line is significant only to the RAM chips (ICs 1-8), as RAM can either be written into or read from.

Additional Notes

Both prototype boards were assembled with the requirement of being able to run CUTER, which requires 2K of ROM addressed at C000 to C7FF and 1K of RAM at C800 to CBFF (hex). Your requirements may be different, but the techniques and examples used here will hold for any combination of ROM and RAM or ROM only.

If you need to expand the basic addressing scheme to handle 16K, then substitute a 74L154 for the second 74LS139 as illustrated by Fig. 6. In fact, if you want to expand further by using 2716s instead of 2708s, you can easily do so by adjusting certain address lines.

Address line A10 will connect to pin 18 of all 2716s. A14 will now connect to pin 20 of the 74LS154, A14 to pin 21 and A12 to pin 23. Pin 13 of 74LS139 goes to ground, and the enable line for 0-31K is pin 12, or for 32 to 65K use pin 11. If the board you build is ROM only, your assembly will be even easier since you need not wire the data-in lines from the bus or even install the wire-wrap pins on these lines unless you want to expand the board one day.

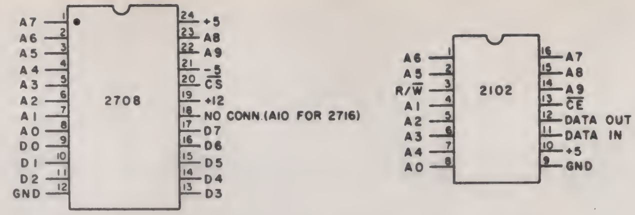


Fig. 5. Pin diagrams of 2102 and 2708 ICs.

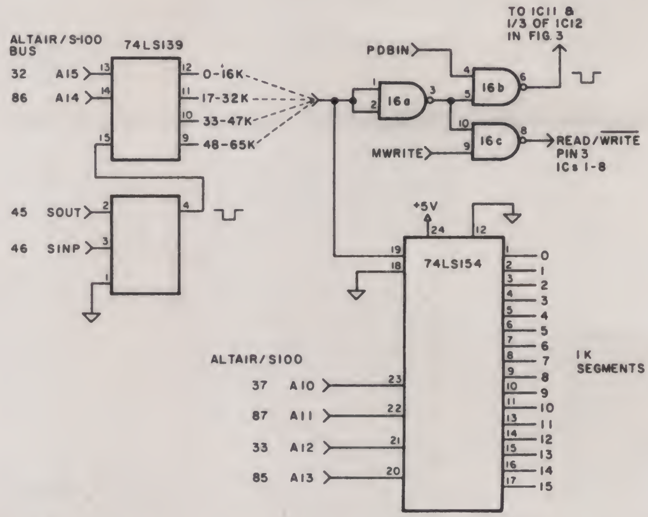


Fig. 6. Addressing expansion to provide for addressing 16 1K blocks. Replaces addressing portion of Fig. 3.

This was a fascinating project, and you shouldn't be afraid to attempt it even if you haven't wire-wrapped anything before. The construction is concise, and there are no little hidden tricks or mysteries requiring solution to get the board to function as advertised.

If your computer doesn't have a front panel on it, your job of checkout will be more complicated, but don't give up yet! Install the voltage regulators first and wire all IC sockets for power and ground, but don't yet connect them to the regulators.

For checkout during assembly use a 5 volt 1 Amp bench power supply to furnish power to the ICs and use jumper clips to either 5 volts or to ground for checking out ICs 14, 15 and 16. Use jumpers again to verify that the data lines are all connected properly, and, finally, connect the regulators and install one 21L02 to check the function of deposit and read with the board installed in the computer.

See, it is a little more difficult this way, but not having a front panel shouldn't discourage you from building this project. ■

IC14a Pin # for $\overline{\text{PAGE}}$	16K Memory Boundary to be selected	IC15a Pin # for $\overline{\text{SELECT}}$	4K Boundary to be selected
12	0-16383	4	0-4095
11	16384-32767	5	4096-8191
10	32768-49151	6	8192-12287
9	49152-65535	7	12288-16383

Table 3. Memory selection table. Use this to select desired pin connections of $\overline{\text{PAGE}}$ and $\overline{\text{SELECT}}$. Note that all numbers used are in decimal.

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End Those Terminal Blues

Lear Siegler's ADM-3A may be the answer.

The clean lines of the ADM-3A, shown being used with an SWTP M6800 system. An 80-character line is greatly appreciated after using terminals with a 32- or 64-character line width.

The Texas A & M Microcomputer Club recently acquired a Lear Siegler ADM-3A display terminal, and somehow we were "volunteered" to assemble it. Upon perusal of the unit, we were impressed by the "Dumb Terminal's" specifications.

- Industry-standard 24 x 80 character display capability (optional) with lowercase display (optional).
- Full or half duplex/RS-232 or current loop operation.
- 103/202 compatible.
- Complete cursor control, including choice of cursor display (underline or block) and home, in addition to direct (x-y) placement.
- Scrolling of filled screen display.
- 12 MHz bandwidth monitor.
- Attractive two-tone molded plastic case.
- 59 key solid-state keyboard.
- Choice of 11 baud rates, switch selectable.

Many of the configuration options are accessible without opening the case by removing the LSI nameplate, which conceals 3 DIP switches. Flexibility is the keyword of the ADM-3A; it may be configured to fit almost any system that requires use of a CRT display. Its price of about $800 for the kit, or $900 for the assembled version, places it in the Teletype range, but, of course, without the hard-copy or tape capabilities.

Construction

In assembling the ADM-3A from a kit, you will notice the terse construction manual appears to have been written for an experienced electronics technician. Those who are accustomed to Heathkit manuals may be dismayed to read, "install resistors on printed circuit board" type instructions.

However, through the use of numerous diagrams and a method whereby the PC board is broken into five "zones," confusion is kept to a minimum. Since only one zone is to be "stuffed" at a time, construction is straightforward with the exception of a few tricky places, which will be outlined below. You can expect to spend about 20 hours in construction if you haven't previously put together an ADM-3A.

Our ADM-3A came with seven pages of revisions to the manual. That sounds like a lot, but is actually less since these included a detailed explanation of construction procedures such as electrolytic capacitor orientation, resistor color code and zone construction techniques.

When the ADM-3A is lifted from its box, you first notice the quality of the packing material. Molded foam about six inches thick is used around the terminal and keeps it from harm during shipping. Parts are separated into hardware, integrated circuits and analog components. The analog components and ICs are packed according to zones to facilitate placement on the PC board.

The case is already assembled and the monitor mounted, which eliminates tedious mechanical work and handling the CRT. All the digital circuitry is contained on one massive 13 x 18 inch PC board. Sockets are supplied, and, since there are about 140 integrated-*circuit* chips (depending on selected options), a lot of soldering is involved to mount the sockets (2000 pins, more or less).

Proceed through the manual. By the time you have installed the heat sinks, power-supply filter capacitors and keyboard, the PC board will be quite heavy. When turning it over to solder components, be careful not to place too much strain on it to avoid causing cracks in the foil traces.

After installing the board, check the voltages (as the manual advises). If they are correct, plug in the ICs and the monitor, and give it the smoke test. Our experience indicates that more caution is needed. We recommend the following sequence.

1. Test and make sure that the +5, +12, +15 and −12 volt regulators are working.
2. Turn off the unit.
3. Install ICs on the PC board. Be particularly careful not to

mix the 74LS157s and the 74LS75s. A good idea is to make several checks of the IC positions several hours apart, or ask a friend to verify the placement. (Note that there is an error on the PC board at IC location J5. The printing specifies a 74LS03. This should be a 74LS08 and is correctly marked in Fig. 3 in the assembly manual.)

4. Connect P3, P4, P5, *but not P7.*

5. Apply power. Buy, beg or borrow an oscilloscope to check J7 pins 8 and 9 for horizontal and vertical drive on the main PC board (timing diagrams in the manual show approximately what these signals should be). This is necessary and critical since this monitor does *not* "free run" if no drive is applied; should the horizontal drive be absent, components in the horizontal deflection circuit, especially the drive transistor, can be burned out from excessive current flow.

6. If the horizontal and vertical drive are present, remove power and plug in P7, making sure it is seated properly.

7. Apply power and, with luck, your monitor should display characters when the keyboard is depressed.

Most of our problems occurred with the monitor, not with the digital circuitry itself. In addition to a blown horizontal drive transistor, the display was *much* too wide, and width coil L6 had little effect. A leaky 50 uF electrolytic capacitor was replaced on the monitor PC board, and we had a display.

We discovered that the schematic included with the documentation omitted some details on the monitor power-supply routing (it should be noted that the monitor is not manufactured by LSI, but is purchased and installed preassembled in the terminal). The schematic failed to show that the 15 volt power-supply lead enters the monitor board through connector J7 pin 7, and is routed through a 2 A Picofuse. It is always nice to know where the fuses are in a unit, should they ever blow out!

Our single remaining problem was that the characters typed on the keyboard seemed to have bit 5 inverted. After some time, we traced the problem to the "fill" switch located one-third of the way back on the right side. This provides an ability to fill the memory with zeros instead of blanks, but the only mention of it is in the detailed circuit descriptions associated with the schematic drawings. We had inadvertently set this switch during construction. So, if you get zeros instead of blanks when the space bar is depressed, flip it and you'll get the appropriate spaces.

User Comments

The quality of the terminal is soon evident. The keyboard has a positive, solid feel, with none of the mushiness associated with some cheaper keyboards. The screen intensity is adjustable and may be set appropriate to the room illumination. The characters are crisp and possess very high contrast. Even in a darkened room, there is no evidence of a background raster scan with the intensity fully advanced. Limited graphics are possible with the direct cursor positioning feature—and a LIFE game on it is quite impressive.

The keyboard may be locked out of the system to prevent interference (from cassette interface or when the system is doing teleprocessing) with data transfers through the terminal. Note, however, that the UART clock is not easily accessible, so cassette systems using a recovered clock may require some modification to the ADM-3A.

The 80-character line width is refreshing after a struggle to fit output into a 32- or 40-character width limitation.

The ADM-3A differs from the previous ADM-3 in that direct cursor addressing is possible, and 74LS-type TTL chips are used throughout, which results in fewer power-supply regulators and, thus, less heat generated and lower power consumed. The ADM-3A also is built around a higher-quality PC board. In our previous dealings with the ADM-3, we found that, in some cases, a few plated-through holes were not completely plated.

In addition, the ADM-3A connection to the video monitor board is better placed. Past experience with the ADM-3 has shown that the plug connecting the monitor to the control logic routes the connecting wires too close to the flyback assembly. The result is a picture that does not have good vertical stability (it rolls). The ADM-3A eliminates this problem by better placement of the plug.

The ADM-3A with clamshell case open to reveal the single major PC board. The keyboard and power supply with heat sinks mount directly onto the main board. Note at the left of the keyboard the option switches, which are accessible with the case closed. The monitor comes preassembled and mounted in the top of the shell, and connection is made to the main board via one plug and cable assembly.

Conclusion

The ADM-3A could be considered the "Rolls Royce" terminal of the computer hobbyist market. It is a professional terminal with advanced features making it quite suitable for any serial data, outboard peripheral application the hobbyist may be contemplating. It is compact, lightweight and consumes little power. For those wishing to go first class, the ADM-3A is clearly a good choice.■

✓ Reader Service—see page 195

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✓P54 **PERCOM** ***'peripherals for personal computing'***

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Off-the-Shelf Word-Processing System

This system is almost comparable to one made by an office-machine company. The big difference is that you'll only pay about one-half as much to put this one together yourself.

I write a model-train newsletter. It usually has 20 pages, quite a few pictures and is offset-printed for quality. I wanted good-looking camera-ready copy that I could produce myself. Since my typing skill isn't all that great, I found that I was spending far too much time trying to get the typewriter to do what my mind said, rather than what my fingers told it.

Many newsletter articles come in longhand from contributers, which requires typing a first draft, making revisions and sending it to them for approval. There are often several changes along the way before they and my proofreader can all agree it is ready for the printer. The word-processing systems seemed to be an answer to my problem. The more I read the ads in magazines and talked to people in computer stores, the more I became convinced that it might be the way for me to go.

With the help of Proko Electronics, 437 Marsh St., San Luis Obispo CA 93401, I came up with a word processor of off-the-shelf components. It costs about half the price of a unit by the office-machine companies . . . about $6500, as opposed to about $13,000. That is still expensive, but it is a tool to increase productivity just as much as, say, a metal-turning lathe. It allows the operator to do a precision job in a fraction of the time that it takes the old way. Since a nontechnical article such as this would have helped me along the way, I thought I'd share some of my experiences.

If some of the print-quality features that I wanted for my application were left out, you could put a system together for about $4000. It would still be usable for many other computing tasks, such as inventory control, accounts and printing mailing labels.

Selecting the System

I had hoped to come up with a low-cost tape cassette storage system, but the more I chatted with people who had tried to use tape recorders, the more the convenience and speed of a disk system figured into my plans. Quality tape drives might have done it, but their cost came close to the cost of disk drives. So, I settled for a disk drive system.

The mini-floppy disks are 5 inch diameter plastic, coated with recording material similar to that used on the tapes. They are mounted in a heavy paper cover with some openings. The disk stays in the cover and is spun by the drive within the cover. The disk can be searched for the wanted material in a fraction of a second, while the tape recorders work at rewind speed.

My system is working great now, and this article is being composed on it. The text in Fig. 1 was printed on my machine. The right-hand margin is straight (justified), and columns can be any width needed—from 25 to 125 characters per line.

The key to the whole system is the Electric Pencil II program written and sold by Michael Shrayer Software (1253 Vista Superba Dr., Glendale CA 91205). This program requires the use of another software disk, CP/M by Digital Research, Inc. There are also versions of the Electric Pencil for similar software such as Imsai's DOS-A and Cromemco's C-DOS.

CP/M and Electric Pencil are available on North Star disks, as are other programs that I felt I might be able to use, such as one for printing mailing labels. That tied down the computer selection for me, since a North Star Horizon II would give me the needed dual disk drives. The CP/M disk and a working copy of the Electric Pencil disk have to be in place while you use the system. There is room to store about 12,000 words of text on a single-side disk along

I write a model-train newsletter. It usually has 20 pages, quite a few pictures and is offset printed for quality. I wanted good-looking camera-ready copy that I could produce myself. Since my typing skill isn't all that great, I found that I was spending far too much time trying to get the typewriter to do what my mind said, rather than what my fingers told it.

Many newsletter articles come in longhand from contributers, which requires typing a first draft, making revisions and sending it to them for approval. There are often several changes along the way before they and my proofreader can all agree it is ready for the printer.

Fig. 1. Sample text.

with the Pencil program.

Since I purchased my system, North Star has switched to double-density disks at no increase in cost, so you get a break there and greater storage. I am using 32K of memory, which lets me have about 3100 words of text to work with before I have to store it on a disk. This is working out OK for the short articles; if I were writing a novel or longer articles, then a third 16K memory board could be added. This would double the number of words that could be worked with before storing them on a disk, since the programs themselves take up about 16K of memory. I soon learned, however, to save on the disk as I went along.

The North Star Horizon II computer, the 17 inch monitor and the NEC Spinwriter. They are mounted on a custom desk with the Spinwriter set at a 30° angle for easier viewing of the monitor.

The Electric Pencil II program requires a memory-mapped video interface, such as the Solid State Music VB1B board. This means that an intelligent terminal isn't needed. In my case I use the keyboard of the NEC (Nippon Electric Co.) Spinwriter as the input device. I am using a 17 inch monitor since it is about 30 inches from my eyes. This makes the words quite readable during long sessions. Dot matrix printers are less expensive than the impact types, but I needed good-quality copy and to be able to change font styles.

My choice of the NEC Spinwriter over a Diablo 1620 was more a matter of availability. The NEC unit uses an interchangeable print thimble rather than the daisy wheel of the Diablo or the ball of the Selectric. It prints at about 450 wpm (55 cps). It can also be used as a typewriter, independent of the computer. I have been completely satisfied with the Spinwriter and have had no experience with a Diablo, so I can't really make a comparison, although the units appear quite similar and appear to be equal in quality.

The Selectric is less expensive, even with the extra keyboard that is needed with some Selectric conversions. For right-hand justification with the Selectric, the space between words is increased, while with the Spinwriter and the Diablo, the space between letters is also changed by using the 120 positions per inch available. I felt that that feature was worth the extra expense for my application.

There is also a conversion of the Spinwriter called the Spinterm. This has the added feature of proportional spacing. A special print thimble is used, and an i takes up less space than a w does, giving an even more professional look to your copy. This unit had just been announced when I bought my system; delivery was uncertain at that time, and only one type style was available.

Using the Word Processor

When you shut the system down there is a possibility of a stray voltage, wiping out data stored on the disks, so remove the two disks *before* shutting down. Therefore, the first thing to do is place a working copy of the CP/M disk in the left-hand disk drive and an Electric Pencil disk in the "B" disk drive. With the power on, the first disk drive comes on and reads the disk, and the CP/M "signs on" the screen. After you type in "B:PENCIL," the second disk is read and the Pencil program "signs on." Push the Escape key to clear the screen, and you are ready to start typing.

The words will appear on the screen. When you get to the end of the first line, resist the urge to hit the carriage return. Just keep on typing and the next line will start to fill. The cursor runs just ahead of the words to let you know where you are working on the screen. The cursor can be moved about on the screen to make corrections.

By holding down the control key and then pressing A, the cursor will move back one letter, and you can then retype that letter to change it. Pressing A several times will move it a letter at a time; S moves it ahead, while W moves it up a line and Z moves it down a line. These four letters form a diamond on the left end of the keyboard and provide simple control of the cursor position. In addition, pressing Q will move the cursor to the top left corner of the screen, and the Tab key will jump it across the line, eight spaces at a leap. The return key moves it to the left margin of the line it is on. That is why it is important not to hit the return key as you do with a regular typewriter, because you will then be typing over the line you just typed. Doing that a few times will be a strong reminder!

There are additional keys that let you delete a letter at a time—to the end of the line or a complete line. Another control lets you insert one letter or a full paragraph, and the existing text just moves on ahead of it as you go. It is fascinating to watch the words shift around on the screen as you add or take out part of what you have written. Another set of controls lets you shift anything from a word to a group of paragraphs from one part of the text to another.

Before I used this system, my rough drafts were full of arrows pointing here and there and blocks of words circled and coded for another part of the text. Now I can make all those changes as I go along and see if that is really what I want. I can try several changes until I am satisfied with the results.

I have found it easy to work with and use it for correspondence as well. Also, for answering routine inquiries about my newsletter, I have a half dozen form letters stored on a disk. I simply add the correct date and name to the appropriate letter, make a change here and there to suit the particular inquiry and print it out at 450 words a minute.

To store what you have written on a disk for later use, place the cursor at the beginning of the text and use the control key and K. This brings up a subsystem on the screen. It will tell you how many words are in the text and gives the codes to use. You will need a file name for the text to be saved. This can be any combination of up to eight characters, as long as it doesn't start with a number. For instance, APRNL3 could be used for the third article for the APRil NewsLetter. I have stored this article as WORD. Don't use the same name for two files on the same disk, or the new one will erase the first one, which can't be recovered.

To store or save the text, type in S WORD 2 and press the return key. After the disk starts up, "Verifying Text" will come on the screen, followed by the list of files on that disk, including the new file, and the deed is done. If you are working with a long text, it is a good idea to save what you have done every 15 minutes or so. Then if the power goes off or if you leave the room and a "helper" comes along, all is not lost.

With the dual disk drive system it is simple to make copies of existing disks. It takes less than a minute. By using copies and keeping the original disk in a safe place, you always have a backup in case you goof. You will need quite a few working copies of the Electric Pencil disks since your text is stored on these disks, rather than on a blank disk.

Restrictions

Because of a quirk in the system (which, I understand, is being changed now), I have to start up the session with a copy of Electric Pencil that has no files stored on it and then shift to the working disk. If a half-full disk is used for start-up, then later even an empty disk will give a "Disk Full" signal when I try to save material.

One other problem: If the new disk isn't seated just right and you try to store the text, you will get a disk error signal, which will take you out of the Electric Pencil program. I haven't found a satisfactory way to get back in again and have lost several hours of typing as a result.

To avoid this problem, I am careful about inserting the disk and have the disk that I am going to use for storage in place before I start typing. Also, when I first put the disk in place I use the control key and K to bring up the subsystem and then use D to get a list of the file names on that disk. This does two things: It confirms that I have the disk that I want and it also runs the disk briefly so that I know it is positioned properly. Then it will be ready to store the text later on.

North Star Horizon II w/16K memory.
Extra 16K memory board.
Solid State Music Video Interface board, VB1B.
Hitachi 17 inch Monitor, Model VM-172AU.
NEC Spinwriter, Model 5520.
CP/M on 5 inch disk, Lifeboat Associates, 164 W. 83rd St., New York NY 10023.
Electric Pencil II.

Table 1. System components.

Program Features

When you are ready to type out the text, you call up the printing subsystem with the control and P keys. The print format is normally set for a full page with right-hand justified margins. This can be changed by simply typing in new commands for line length, page length, left margin and non-justify. The text can be double-spaced, and there is a feature that will add a title and automatic page number to each sheet.

Part of the printing format is determined as you originally type the text. For this article I used a line feed between each paragraph and didn't indent the first line. Any indenting must be done in the text, and the Tab key will do that for you. Columns are also determined in the text.

If you don't use rolls of paper with your machine, then the printing command F1 will stop the machine at the end of the sheet and wait for you to change paper. Pushing the return key will start it printing the next page. Print commands can also be placed in the text itself and can then make that paragraph narrower or double-spaced or whatever fits your needs.

If you want to work with text that you saved earlier, then put that disk in the second disk drive and again ask for the directory of that disk to check that it is the right disk and that it is seated properly. Then typing L WORD 2 will load the text into the memory of the computer. The Escape key will bring it up on the screen. There are controls to have the text scroll up or down on the screen at various speeds, and a touch of the space bar will stop and start the scrolling.

There is another fascinating feature of the Electric Pencil program: the string search. A string is usually a word that you are hunting for, but it can be any combination of characters that you want to find. The control and V keys bring this feature into use, and the screen will display Search String? If you type in any string of characters such as *memory* and hit the return key, it will display the first line of text that contains that word. Control C will bring up each succeeding time it is there.

I find this feature convenient to find the words that my proofreader says need changing. It would be invaluable if the text that you were working with had to have an index.

This feature can also be used in another way. If you type in, say, "company/corporation," then the word company will be changed to corporation throughout the text, and the screen might display "Located 'company' 23 times." If you find that you have misspelled a word consistently, this feature could be used to find and change it thoughout the text... and in a fraction of a second!

Related Reading

The manual that comes with the Electric Pencil II is well done and easy to understand. I have made simple notes on 3½ x 5 inch cards for the various commands, but after the first few days of use, I seldom needed to refer to them. The Horizon II is available as a kit, and the instructions for that are quite complete. If you have put other electronic kits together, you should have no problem with the computer.

Someone else at North Star must have written the instructions for the DOS (disk operating system) and their version of BASIC that came with my unit. If you fully understand computers, no doubt they will be quite adequate. There is an expanded and easier-to-understand *System Software Manual* with the new double-density Horizon models. The manual goes into the steps needed to personalize the disks to suit your particular system. If you are a novice, you may still find that this is best left to your friendly computer store.

If you want to take full advantage of your system for more than word processing, then you will need to know how to work with BASIC in general, and the North Star version in particular. Luckily, there is help in understanding how to operate the computer with BASIC. Robert Rogers went through the agony of learning to use his new computer from scratch and has written, in non-computer talk, a book, *The Users Guide to North Star BASIC*, published by Interactive Computers, 7620 Dashwood, Houston TX 77036. It is based on his experiences with a single disk North Star unit used with his SOL-20 computer. Some of what he talks about doesn't apply to my system, but there are enough plain-talk explanations to make the book well worth the cost for a novice. ■

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Catching Bugs with Lights

This hardware approach to software debugging could save you many headaches.

In debugging a program, how often have you wished you could *see* the contents of the accumulator or the status register at each step *without* pushing all those buttons? If you are interested in a simple hardware solution to this problem, read on.

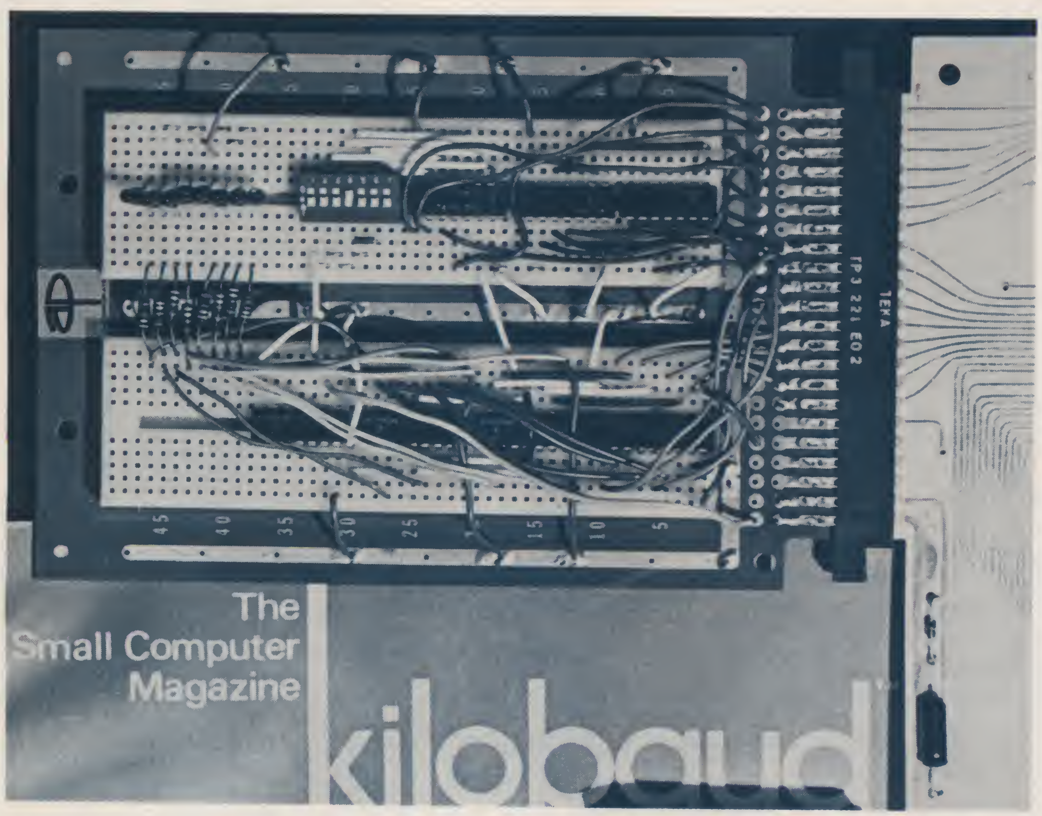
Although my circuit was designed for the KIM-1, the idea certainly is applicable to other systems. Even if you're not interested in my Bug-Light circuit for programming purposes, it gives you one or more output ports in page zero of memory, and it makes a useful tool for teaching programming.

Introduction

The KIM-1 monitor and a little hardware provide you with a single-step mode in which the program may be executed one instruction at a time. After each instruction is executed, the resident monitor program stores the contents of the accumulator, the status register, X-register, Y-register and other registers (see Table 1 for the locations of each register). The important registers are also saved in zero page when a break (BRK) command is placed in a program and the IRQ vector is 1C00. Both the single-step (SST) mode and the break-to-KIM monitor are used extensively in debugging programs.

Use of the SST mode is explained in the KIM-1 User Manual, while the break-to-KIM-monitor technique is explained in *The First Book of KIM*. With either technique the contents of the various registers may be read by using the keyboard to look up the locations in zero page where their contents are stored. For example, to see what the contents of the accumulator are after an instruction, simply address location 00F3 with the keyboard to display it on the seven-segment display.

It's a great feature, but it's slow. At least six consecutive key depressions must take place to examine a register, restore the program counter and execute the next instruction in the program. If you're following your program around some crazy loop to see why it never comes out, this procedure can take a lot of time. Perhaps my arthritic fingers and bouncy keys are the problem. There has to be a faster approach to the register display problem. A reasonable objective, I decided, was an LED display of each bit in a particular register, with no extra key depressions.



What's in front of the Kilobaud*? The Bug-Light circuit.* *(Photo by Paul Campbell, S of O student)*

Enter Bug-Lights

To accomplish this objective I designed a circuit to decode the addresses of the locations where the various register contents were stored and allow the microprocessor to WRITE the same data to output ports with LEDs to represent each bit. Thus, when the monitor stores the contents of the status register at location 00F1, it also writes the same data to an output port whose address is 00F1. In this case the LEDs indicate the state of the various flags. If

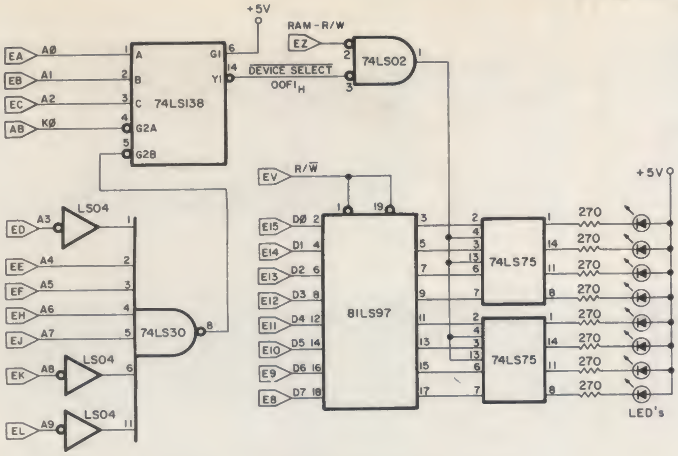


Fig. 1. The basic Bug-Light circuit.

Address	Label	Contents
00EF	PCL	Program Counter Low
00F0	PCH	Program Counter High
00F1	P	Status Register (Flags)
00F2	SP	Stack Pointer
00F3	A	Accumulator
00F4	Y	Y-Register
00F5	X	X-Register
00F6	CHKHI	Cassette Checksum High
00F7	CHKSUM	Cassette Checksum Low

Table 1. Zero Page Memory locations of the various registers.

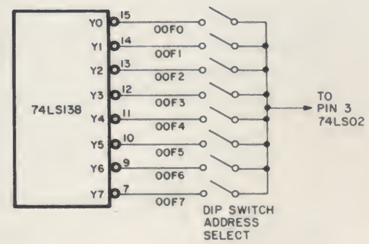


Fig. 2. Use of a DIP switch to select the register to be displayed.

the output port has address 00F3, then the LEDs will show the contents of the accumulator, in binary, of course.

Bug-Lights comes in three versions. The basic circuit is shown in Fig. 1. It will display one register only. A modification that increases the utility of the basic circuit is shown in Fig. 2. The DIP switch allows you to select which register you want to follow as you step through your program. If you really like blinking lights and/or do a lot of programming, see the chrome-plated modification to display up to eight registers simultaneously as outlined in Fig. 3.

Of course, the most important registers to display are the accumulator, the status register, the X and Y registers and perhaps the stack pointer. These displays would make an impressive yet functional front panel. My personal version has the DIP switch modification shown in Fig. 2. (The program counter low, PCL, is stored at address 00EF and cannot be observed with the Bug-Light circuit. I cannot recall ever using this register to debug a program.)

How Bug-Lights Works

We will begin with the address decoding circuitry. The 74LS138 decoder/demultiplexer will decode the lowest three address lines (A0, A1, A2) when G1 is at logic 1 and G2A and G2B are at logic 0. G1 is tied high, eliminating any further consideration of it.

In order to have both G2A and B at logic 0, the $\overline{K0}$ select from the KIM-1 and the output of the 74LS30 must be at logic 0. K0 will be low when address lines A10-15 are low. This is handled by the KIM-1 circuitry. You can see from Fig. 1 that the output of the 74LS30 is low when A4-A7 are at logic 1 and A3, A8 and A9 are at logic 0. The compilation of this information as the requirements to select the 74LS138 are shown in Example 1.

The 74LS138 decodes the lowest three address lines to produce active low *device select pulses* whenever addresses 00F0-00F7 are on the address lines. Each of the eight outputs of the 74LS138 corresponds to one of the eight addresses 00F0-00F7, which in turn include the address of the locations where the various registers are stored.

The device select pulse from the 74LS138 is inverted and ANDed with the inverted RAM-R/$\overline{W}$ signal from the KIM-1. This produces a positive pulse from the 74LS02, which occurs only on a WRITE cycle and when the correct address is placed on the address bus. For example, an STA 00F1 instruction will produce such a pulse in the circuit of Fig. 1. This pulse is applied to the gate inputs of the 74LS75 Bistable Latches.

As long as the positive pulse is applied to the 75LS75 gates, the Q outputs follow the D inputs, and the $\overline{Q}$ outputs are the D inputs inverted. At the trailing edge of the positive pulse, which occurs when the Ø2 clock signal on the KIM-1 changes from logic 1 to logic 0, the data at the D inputs is latched into the Q outputs. So when a WRITE occurs to 00F1, the data will appear at the Q outputs and it will be stored there, at least until another WRITE to 00F1 occurs.

The 81LS97 is a data bus buffer. It is activated only on a WRITE command when the R/$\overline{W}$ is low. If only one output port is desired and the data bus lines are kept short, then the 81LS97 may be omitted since the 6502 microprocessor can drive the 74LS75s directly. However, if you want to locate your lights on a front panel, or if you want to add sets of eight lights for several registers, then the bus driver becomes essential.

The LEDs are connected through current-limiting resistors to the $\overline{Q}$ outputs of the 74LS75s. They will glow when $\overline{Q}$ is low and Q is high. Thus a glowing LED corresponds to a logic 1 for the bit it represents while an LED in the off state corresponds to a logic 0.

Bug-Lights, Output Ports or Both

An added feature of the Bug-Light circuit is its ability to be used as an output port as well as a debugging tool. The Q outputs of the 74LS75s are not used for display purposes, and they contain the data that was written to them. Thus, they can be used as zero-page, memory-

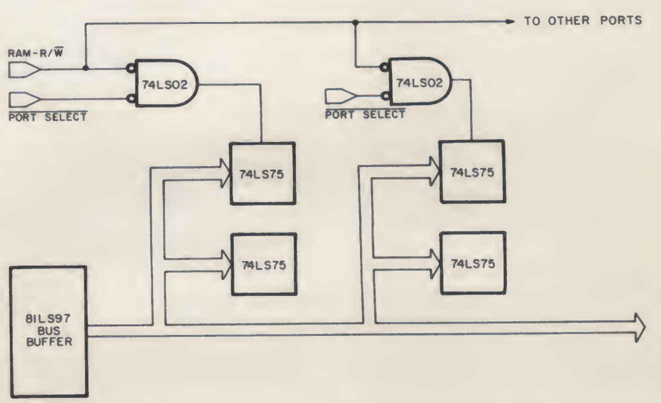
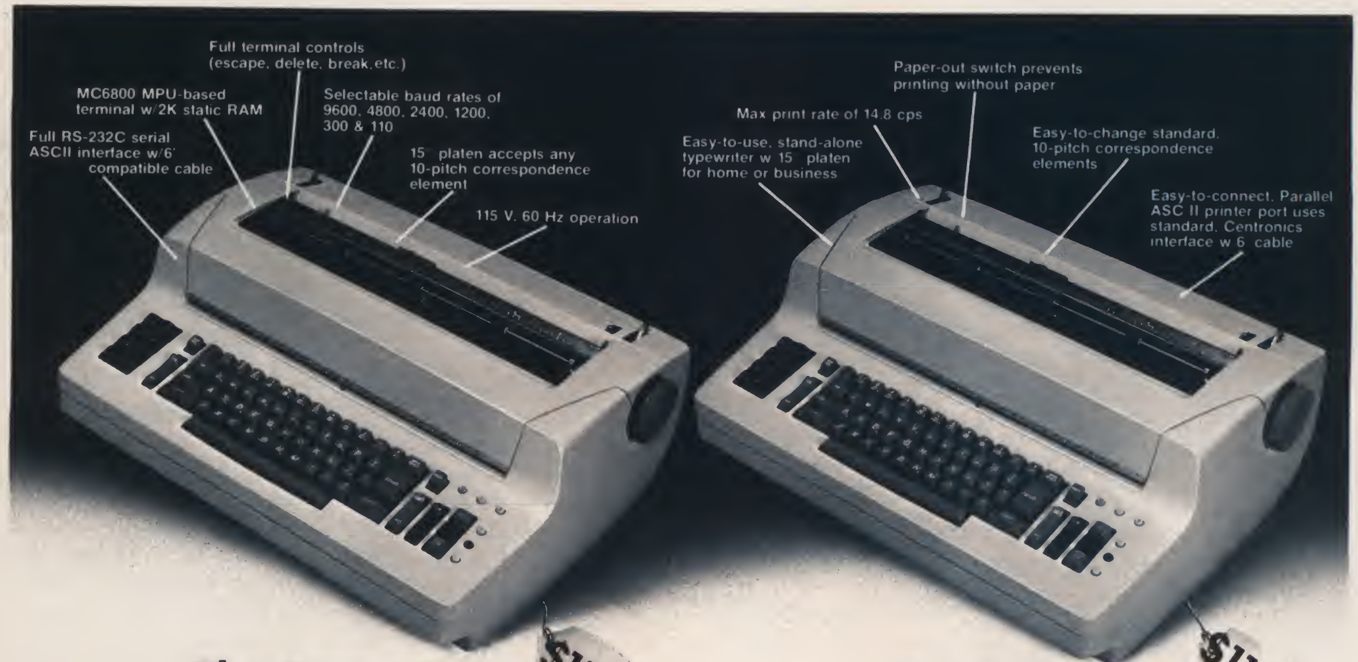


Fig. 3. Circuit of Fig. 1 expanded to output several registers simultaneously. Each pair of 74LS75s makes one 8-bit output port. Port selects are from the 74LS138 decoder.

How to buy IBM Selectric Terminals.



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A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	—Address Line
0	0	0	0	0	0	0	0	1	1	1	1	0	X	X	X	—Logic Value
0				0				F				0-7				—Hex Number

Example 1.

```
BEGIN   LDA $01
THERE   ASL A
        JMP THERE.
```

Example 2.

Integrated Circuit	+5 V	Ground
74LS138	16	8
74LS30	14	7
74LS02	14	7
74LS04	14	7
74LS75	5	12
81LS97	20	10

Table 2. Power connections for the Bug-Light integrated circuits.

mapped output ports.

An application program can make use of these ports to write a 7-bit ASCII word to some external device such as a video card, an IBM Selectric or some other device. A/D or D/A converters can be driven from these ports as easily as the PAD and PBD ports on the KIM-1 application connector. The only time the memory locations 00F0-F8 are used by the computer is in an NMI or IRQ jump to the monitor, that is, in debugging. So you can have your Bug-Lights and output ports as well.

Construction

Table 2 shows the power connections for each of the chips in the logic diagram. All the other connections are given in the figures. My version was built on a UNICARD I, containing two breadboard strips and an edge connector pad that matches the KIM-1 expansion pad. I soldered an edge connector to the UNICARD so I could plug the KIM-1 expansion pad into it. All the connections of the Bug-Light circuit except one are to the expansion pad on the KIM-1. All the connections are found on the pad symbols in Fig. 1. The $\overline{K0}$ select comes from the application pad on the KIM-1. Its pin number, AB, is also given.

Layout is not critical, and other approaches than the one I used will work. A wire-wrap approach might be more permanent and less expensive, although I have found that the circuits on the breadboards last indefinitely. The accompanying photograph shows my version. Power was stolen from the KIM-1 power supply, since both +5 V and ground are available at the expansion pad.

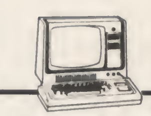
When you get your circuit built, say a one-port version, select the location you want to view with the DIP switch or by the appropriate connection. With the KIM-1 running in the monitor, address the location and store FF in it using the keypad on the KIM-1. All the LEDs should light. Change the contents of the port until you are sure that each LED is responding to the correct bit value. Stepping through the sequence 00, 01, 02, 04, 08, 10, 20, 40, 80 of data values will test each light in turn.

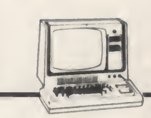
Next, load any program, set the KIM-1 up for the SST mode and step through the program. The lights should reflect the current contents of the register you have selected to view. I had no trouble. For once my design worked the very first time I tried it. I hope you have the same kind of success. If you don't, recheck all your wiring, check the polarity on your LEDs, make sure they all work and finally make sure you haven't made a mistake on numbering the pins on the ICs.

If some bits work and some don't, then exchange signal paths for the two bits. For example, if one bit is working, then the 74LS75 latch for this bit will also be working. Use the same latch for a nonworking bit to see if the problem is in the latch. The circuit is simple enough so that it should not take too long to figure out any problems.

Beginning programmers have a lot more trouble visualizing what is happening as a result of a certain instruction than veteran programmers imagine. One application of Bug-Lights is to illustrate the results of various instructions. For example, set up Bug-Lights to show the contents of the accumulator (00F3). Then write a short program (shown in Example 2) in which the accumulator is loaded with 01 followed by an ASL A in an infinite loop.

Now single-step through the program and watch the 1 move from right to left on the LEDs. Replace the ASL A with a ROL A and note the difference. Other instructions can be illustrated in the same way, giving students who have difficulty visualizing zeros and ones among bits and bytes an excellent visual aid. ■





✓ Reader Service—see page 195

Make PET Hard Copy Easy

Interfacing ASCII or Baudot printers to PET's IEEE bus is a snap with this circuit.

Dr. James M. Downey
5505 Vanderbilt Dr.
Mobile AL 36608

Many PET owners want hard copy from their machines but have been frustrated by either the slow delivery or the high price of the PET printer. Well, if you have had some experience in building eight-chip circuits and can get your hands on either an ASCII or Baudot printer, then this interface is probably just for you.

This article describes a simple interface that was the brainchild of Don Rindsberg of The Bit Stop (a local consulting firm in Mobile specializing in microprocessor applications). The interface accepts the output, which PET places on the IEEE-488 bus, converts it to either Baudot or ASCII, sends serial signals to the printer and, of course, makes all the complex handshakes between it and PET.

The interface fully utilizes the printer features that are built into the PET's operating system with only one important exception: You can only print those characters that are supported by the printer, and that means no fancy graphics. But you will still be able to list programs, print the payroll, etc. If you can live with that constraint, then please read on.

How many chips are required to do this? Just to take ASCII characters off the IEEE bus might only require four or five, but to make a proper handshake would surely add a half a dozen more. If you then include logic to mask out graphic characters, to provide the delay after each carriage return (which most printers require) and to count the columns for printers that do not have the full 80 columns, as a proper interface should do, you are suddenly faced with more chips in the interface than there are in PET. And, if you want it to convert ASCII to Baudot on top of all of

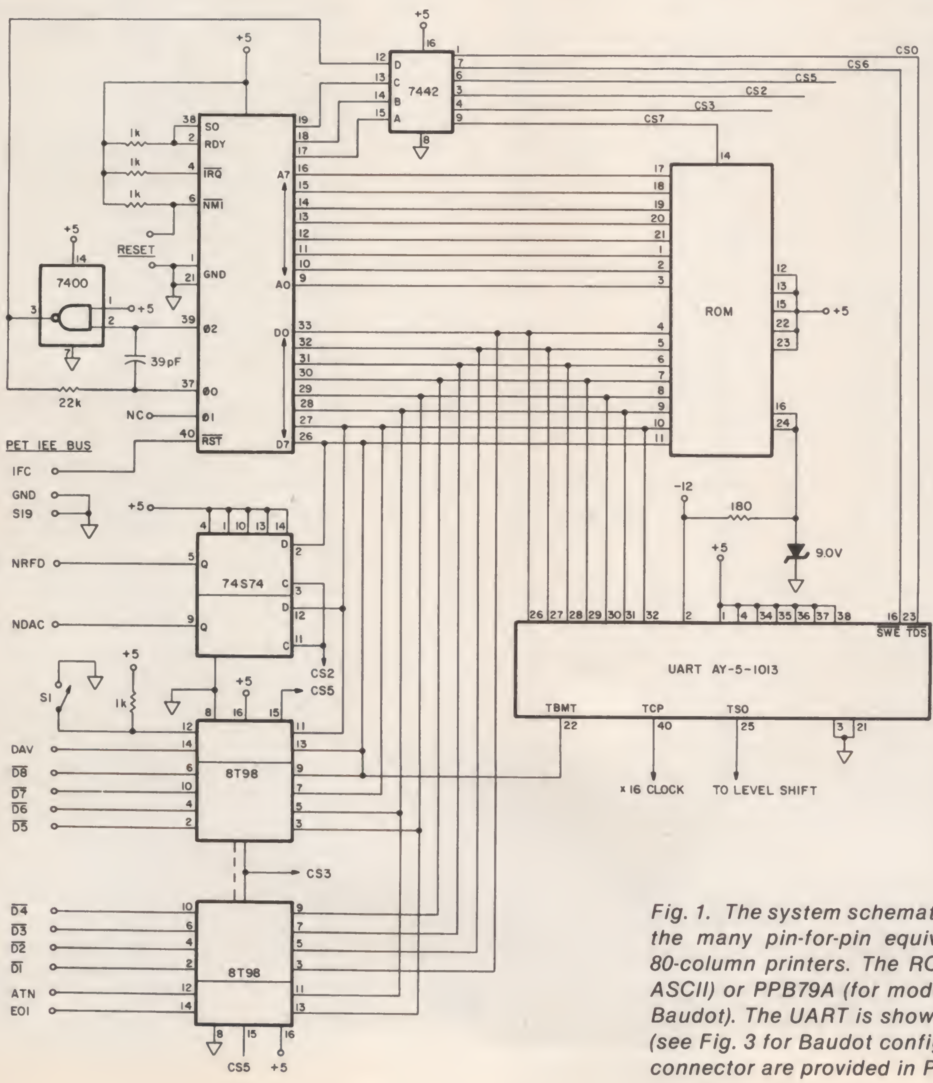


Fig. 1. The system schematic. The UART is an AY-5-1013 or one of the many pin-for-pin equivalents. Switch 1 selects for 72- or 80-column printers. The ROM is The Bit Stop ROM #PPA79 (for ASCII) or PPB79A (for model A Baudot) or PPB79B (for model B Baudot). The UART is shown wired for an 8-bit ASCII-type printer (see Fig. 3 for Baudot configuration). Pin-outs for PET's IEEE bus connector are provided in PET's user manual.

that . . . well, forget it!

The secret to raising the IQ and lowering the chip count of the interface is to make one of those chips in the interface a microprocessor. "Another microprocessor?" you say. Why not . . . since they only cost $12-$14 on today's market? Well then, which microprocessor? Why the 6502, of course! Its on-board clock reduces the number of support chips, and more important, its internal registers are sufficient to eliminate the need for any scratchpad RAM.

The author's PET with his Texas Instruments silent writer.

A Closer Look

The circuit is shown in Fig. 1. The total chip cost should be less than $50, and all support chips are readily available, in fact, probably in your own junk box. The most striking feature of the circuit is that it uses no RAM, since the 6502 itself has sufficient internal registers for temporary storage. The smarts for this system reside in a preprogrammed ROM developed by The Bit Stop. (ROMs are available for $25 each at The Bit Stop, Box 973, Mobile AL 36601. Specify part number PPA79, PPB79A or PPB79B.)

Three versions of this ROM are currently available: one for ASCII, the PPA79; one for model A Baudot machines, the PPB79A; and one for the model B Baudot, the PPB79B. To differentiate between the model A and B Baudot printers, the former types $ for shift-D, while the latter prints t.

Switch 1 in the schematic selects for either a 72- or 80-column printer. Since PET outputs an 80-column line, the interface simply folds the line when a 72-column format is selected.

Serial code for the terminal is provided by a UART, and the user must choose a level-shifting network from Fig. 2 that is appropriate for his printer. The 6502 in the interface resets when PET is reset via the IFC line and also by a manual push button. On reset the interface outputs eight line feeds, which not only lets the user know that the interface and printer are working, but also provides a convenient way to get your copy out of the machine—just push the button once or twice and up it comes.

What Happens to the Graphics?

Since the graphic characters cannot be printed, they are intercepted by the interface and appear as either a space or are converted to the lowercase of the letter keys on which the graphic resided. If your printer supports lowercase, this helps to identify the graphics when reading listed programs.

The Baudot version further requires the conversion of modified ASCII, which the PET outputs, to Baudot. Of course, it introduces the appropriate shifts to switch between letters and figures. Another problem with Baudot code is the lack of symbols for equal, greater than, etc. The interface solves this by outputting special double characters, e.g., 'E for equals or 'G for greater than. For oddball graphics, it simply outputs a space.

With this interface, the PET BASIC commands for outputting to a printer are all valid, since we are using the IEEE-488 output rather than the user port. CMD 4 and PRINT#4, as well as the other commands, work with this interface.

Let's Build It

Wire-wrap construction is recommended, and if you lay out the board carefully, you can fit the entire interface on a 4 × 4.5 inch board such as is available from Radio Shack or Vector. Regulated power at +5 volts and −12 volts can be generated from PET's transformer or from a separate power supply in the interface. One-half Amp of +5 and 100 mA of −12 are required.

Before connecting the interface to the PET it should be initially checked by powering it up and pushing the reset button. If all is well, eight line feeds will be transmitted. If the interface passes that test, double-check the wiring once more and plug it into the IEEE port in the back of the PET and give it a try; it should work.

There are some differences in the circuit between the Baudot and the ASCII version of the interface (see Fig. 3). The op-

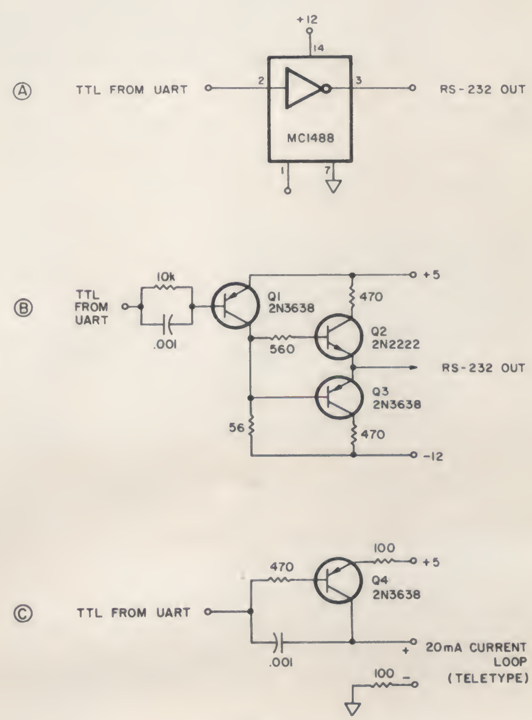
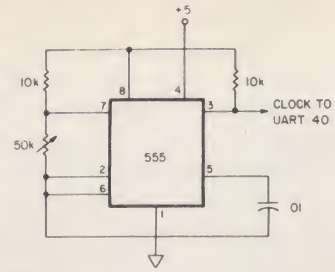


Fig. 2. Three level-shifting networks are shown. Either of the top two will work for RS-232 printers, while the bottom one should be used for 20 mA current loop types such as a Teletype or DECwriter.

tions for wiring essentially reconfigure the UART for either the 5- or the 8-bit codes. Some of the OEM printers on the market require a parallel, rather than serial, interface. This can be accomplished by eliminating the UART and placing latches on each of the eight data lines. Data can be strobed into the latches by CS0, and the printer busy signal will have to be strobed into data line seven in a Tri-state manner by use of CS3.

We've used this interface on a wide variety of printers (Teletypes, GE, Texas Instruments, Diablo) without encountering any problems. If you have a nonstandard printer (e.g., 40 columns instead of 72 or 80), I suggest that you drop Don Rindsberg a line at The Bit Stop. He enjoys the challenge, and chances are good that for a nominal fee he will provide you with a custom ROM, so your printer will be PET-able too. ■



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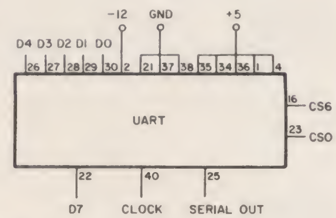

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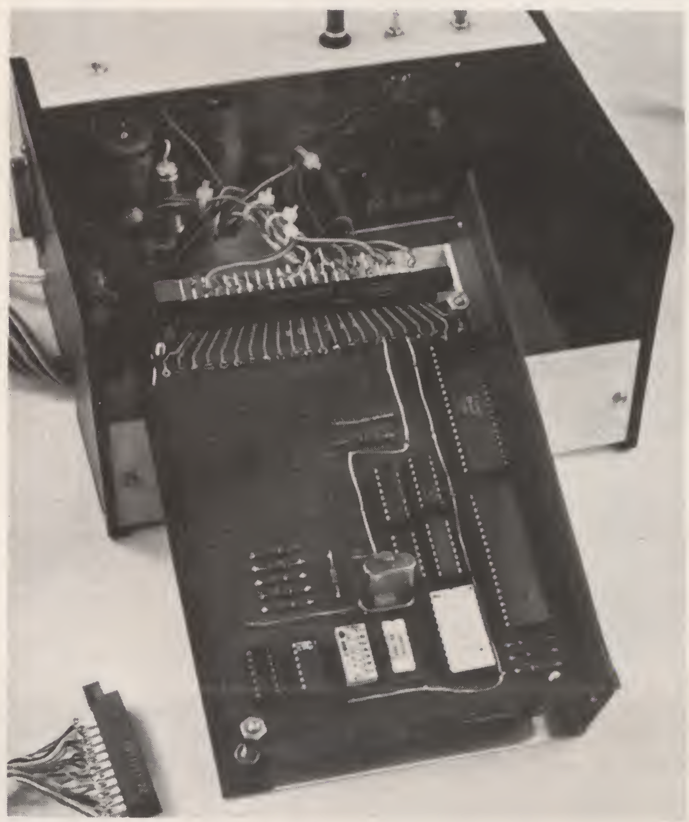
Fig. 3. A simple baud rate generator (top) using a 555 integrated circuit. The output frequency should be 16 × the baud rate. The wiring differences between the ASCII and the Baudot versions are shown in the lower section.



A close-up of the author's interface. Wire-wrap construction was used, and the whole circuit fits on one board easily. The box contains a simple ±12 volt power supply. +5 volts was generated by tapping PET's 8 volt unregulated bus and dropping it to 5 volts with a regulator IC.

Reader Service—see page 195

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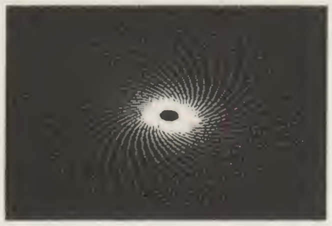

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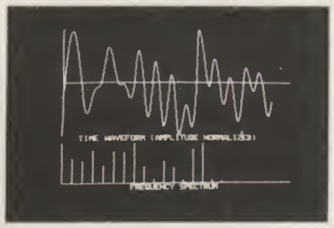

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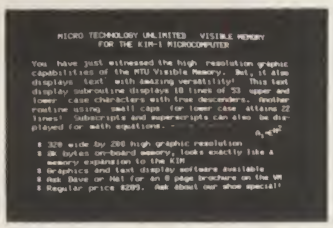

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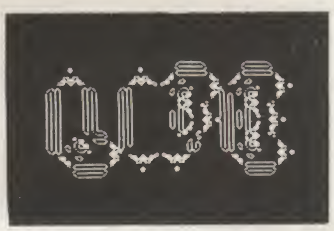

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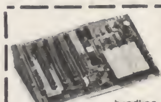

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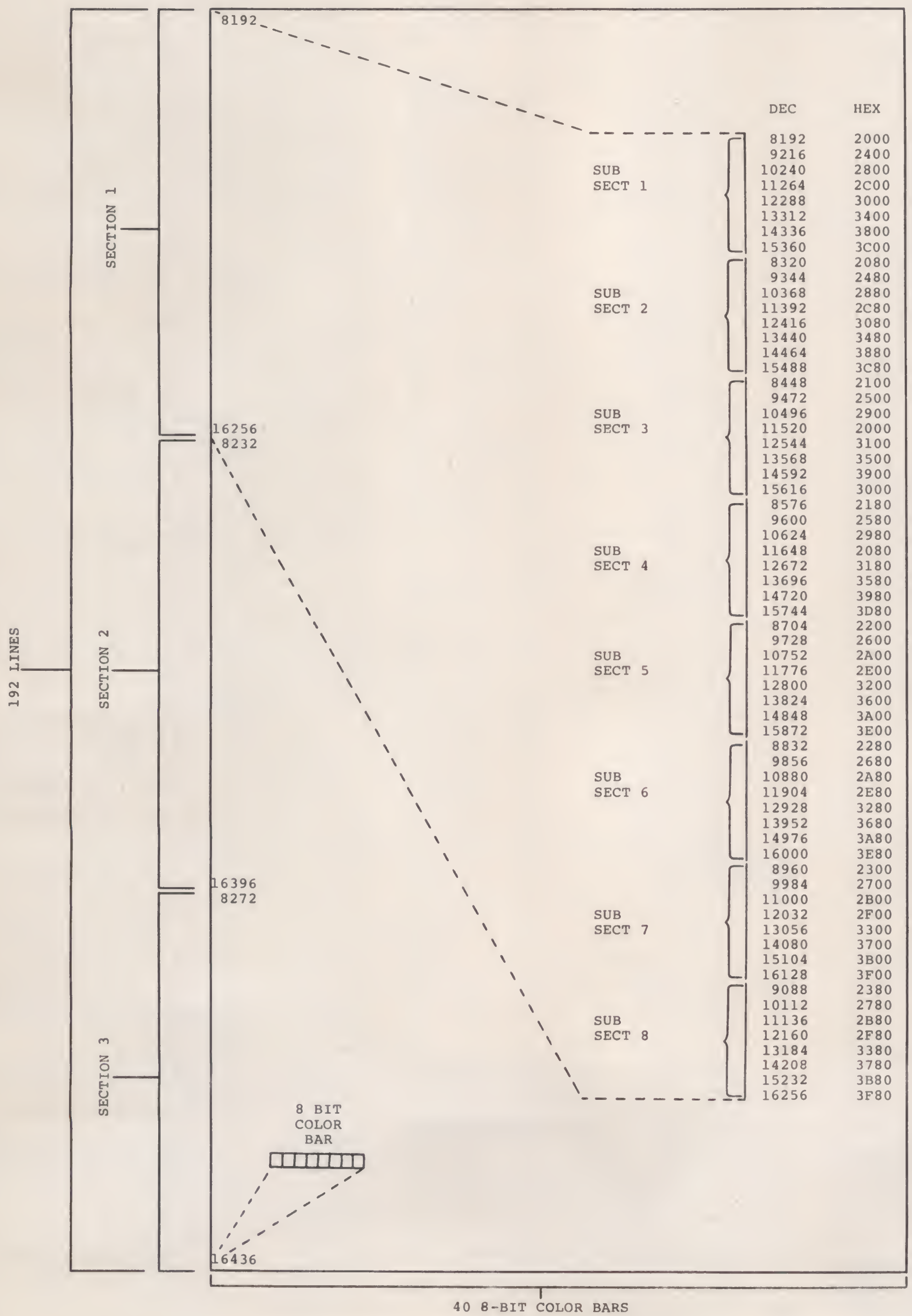

Fig. 2.

I have had my Apple II for about six months now and have thoroughly enjoyed it. I have written an inventory system, a word processor and a universal database for the Apple II, but my most rewarding accomplishment came when I conquered the high-resolution graphics. This achievement is what I am going to share with you in this article.

If you are like me and had tried to POKE a number into the high-resolution-graphics contiguous memory locations, you were perplexed by the way it was displayed on the screen. If you have not tried it yet, listen to my experience. I set up the routine in Fig. 1 and ran it.

Screen Display

The screen, as broken down in Fig. 2, displayed a tiny violet dot starting at the top left (location 8192) and proceeded to the right-hand side of the screen. When it ran off the right-hand side, it reappeared again one-third down the screen at section 2, location 8232 and proceeded to the right again. As before, it disappeared and reappeared again on the left, but this time it began two-thirds down the screen at section 3, location 8272. (Keep in mind that so far these numbers are only 40 positions apart.)

The dot left the screen on the right and reappeared again at the top of the screen—no, not under the first line on top but eight lines below it at section 1, subsection 2, location 8320. It filled that line then jumped to section 2, subsection 2, line 1, then to section 3, subsection 2, line 1, then back up to section 1, subsection 3, line 1 until it filled

```
10  POKE - 16304, 1
20  POKE - 16297, 0
30  FOR X = 8000 TO 17000: POKE X, 1: NEXT X
40  END
```

Fig. 1.

Point P = 8192 + (A*40) + (B*128) + (C*1024)

Example 1.

```
10  FOR LN = 1 TO 192
20  A = LN/64
30  B = A/8
40  C = A MOD 8
50  P = (8192 + (A*40) + (B*128) + (C*1024))
60  POKE P, 1
70  NEXT LN
```

Fig. 3.

all lines 1 of each subsection. Then it finally jumped back up to the second line of section 1, subsection 1 and repeated the whole cycle again until the screen was full of dots.

I thought to myself that this is not the way to put a computer together. I could not even conceive of attempting to write a program that would draw an object going up or down the screen. Robert Bishop did just that in his game program ("Rocket Pilot," *Kilobaud* No. 13, p. 90), so I pressed on to find out if I could.

As shown in Fig. 2, the screen has 192 horizontal lines that are broken up into three sections of 64 lines each. Each section is broken up into eight subsections of eight lines each. Each section is 40 locations apart; each subsection is 128 locations apart; and each line within a subsection is 1024 locations apart. What a mess!

Formulas

After many, many hours of studying that mess, I decided that there should be some formula to plot a point on the screen with only one known variable, a line number (LN) between 1 and 192; therefore, using this basis, I came up with the following.

- To find what section LN is in, divide LN by 64 giving the section A.
- To find out what subsection LN is in within the section, divide A by 8 giving subsection B.
- To find out what line LN is on within subsection B, divide A by 8, and then C is equal to the remainder.

Next, I had to reconstruct the pieces to give me the starting point. The first memory location used in high resolution is 8192. I came up with the formula for reconstruction as shown in Example 1. I put these calculations in the routine in Fig. 3 and ran it.

The result was a dot drawn on line 1, position 1, then on line 2, line 3 and so on down the left side of the screen in the first position. So far, so good. Now that I had found the starting points for each line, I had to draw dots across the screen from the starting point and go all the way to the right side.

Since there were only 40 locations from one section to another, each line had to con-

DEC	HEX	BAR DISPLAY							
		1	2	3	4	5	6	7	8
0	0								
1	1	.							
2	2		/						
3	3	.	/						
4	4			.					
5	5	.		.					
6	6		/	.					
7	7	.	/	.					
8	8				/				
9	9	.			/				
10	A		/		/				
11	B	.	/		/				
12	C			.	/				
13	D	.		.	/				
14	E		/	.	/				
15	F	.	/	.	/				
16	10					.			
17	11	.				.			
18	12		/			.			
19	13	.	/			.			
20	14			.		.			
21	15	.		.		.			
22	16		/	.		.			
23	17	.	/	.		.			
24	18				/	.			
25	19	.			/	.			
26	1A		/		/	.			
27	1B	.	/		/	.			
28	1C			.	/	.			
29	1D	.		.	/	.			
30	1E		/	.	/	.			
31	1F	.	/	.	/	.			
32	20						/		
33	21	.					/		
34	22		/				/		
35	23	.	/				/		
36	24			.			/		
37	25	.		.			/		
38	26		/	.			/		
39	27	.	/	.			/		
40	28				/		/		
41	29	.			/		/		
42	2A		/		/		/		
43	2B	.	/		/		/		
44	2C			.	/		/		
45	2D	.		.	/		/		
46	2E		/	.	/		/		
47	2F	.	/	.	/		/		
48	30					.	/		
49	31	.				.	/		
50	32		/			.	/		
51	33	.	/			.	/		
52	34			.		.	/		
53	35	.		.		.	/		
54	36		/	.		.	/		
55	37	.	/	.		.	/		
56	38				/	.	/		
57	39	.			/	.	/		
58	3A		/		/	.	/		
59	3B	.	/		/	.	/		
60	3C			.	/	.	/		
61	3D	.		.	/	.	/		
62	3E		/	.	/	.	/		
63	3F	.	/	.	/	.	/		
64	40							.	
65	41	.						.	
66	42		/					.	
67	43	.	/					.	
68	44			.				.	
69	45	.		.				.	
70	46		/	.				.	
71	47	.	/	.				.	
72	48				/			.	
73	49	.			/			.	
74	4A		/		/			.	
75	4B	.	/		/			.	
76	4C			.	/			.	
77	4D	.		.	/			.	
78	4E		/	.	/			.	
79	4F	.	/	.	/			.	
80	50					.		.	
81	51	.				.		.	
82	52		/			.		.	
83	53	.	/			.		.	
84	54			.		.		.	
85	55	.		.		.		.	
86	56		/	.		.		.	
87	57	.	/	.		.		.	
88	58				/	.		.	
89	59	.			/	.		.	
90	5A		/		/	.		.	
91	5B	.	/		/	.		.	
92	5C			.	/	.		.	
93	5D	.		.	/	.		.	
94	5E		/	.	/	.		.	
95	5F	.	/	.	/	.		.	
96	60						/	.	
97	61	.					/	.	
98	62		/				/	.	
99	63	.	/				/	.	
100	64			.			/	.	
101	65	.		.			/	.	
102	66		/	.			/	.	
103	67	.	/	.			/	.	
104	68				/		/	.	
105	69	.			/		/	.	
106	6A		/		/		/	.	
107	6B	.	/		/		/	.	
108	6C			.	/		/	.	
109	6D	.		.	/		/	.	
110	6E		/	.	/		/	.	
111	6F	.	/	.	/		/	.	
112	70					.	/	.	
113	71	.				.	/	.	
114	72		/			.	/	.	
115	73	.	/			.	/	.	
116	74			.		.	/	.	
117	75	.		.		.	/	.	
118	76		/	.		.	/	.	
119	77	.	/	.		.	/	.	
120	78				/	.	/	.	
121	79	.			/	.	/	.	
122	7A		/		/	.	/	.	
123	7B	.	/		/	.	/	.	
124	7C			.	/	.	/	.	
125	7D	.		.	/	.	/	.	
126	7E		/	.	/	.	/	.	
127	7F	.	/	.	/	.	/	.	
128	80								/
129	81	.							/
130	82		/						/
131	83	.	/						/
132	84			.					/
133	85	.		.					/
134	86		/	.					/
135	87	.	/	.					/
136	88				/				/
137	89	.			/				/
138	8A		/		/				
139	8B	.	/		/				/
140	8C			.	/				/
141	8D	.		.	/				/
142	8E		/	.	/				/
143	8F	.	/	.	/				/
144	90					.			/
145	91	.				.			/
146	92		/			.			/
147	93	.	/			.			/
148	94			.		.			/
149	95	.		.		.			/
150	96		/	.		.			/
151	97	.	/	.		.			/
152	98				/	.			/
153	99	.			/	.			/
154	9A		/		/	.			/
155	9B	.	/		/	.			/
156	9C			.	/	.			/
157	9D	.		.	/	.			/
158	9E		/	.	/	.			/
159	9F	.	/	.	/	.			/
160	A0						/		/
161	A1	.					/		/
162	A2		/				/		/
163	A3	.	/				/		/
164	A4			.			/		/
165	A5	.		.			/		/
166	A6		/	.			/		/
167	A7	.	/	.			/		/
168	A8				/		/		/
169	A9	.			/		/		/
170	AA		/		/		/		/
171	AB	.	/		/		/		/
172	AC			.	/		/		/
173	AD	.		.	/		/		/
174	AE		/	.	/		/		/
175	AF	.	/	.	/		/		/
176	BO					.	/		/
177	B1	.				.	/		/
178	B2		/			.	/		/
179	B3	.	/			.	/		/
180	B4			.		.	/		/
181	B5	.		.		.	/		/
182	B6		/	.		.	/		/
183	B7	.	/	.		.	/		/
184	B8				/	.	/		/
185	B9	.			/	.	/		/
186	BA		/		/	.	/		/
187	BB	.	/		/	.	/		/
188	BC			.	/	.	/		/
189	BD	.		.	/	.	/		/
190	BE		/	.	/	.	/		/
191	BF	.	/	.	/	.	/		/
192	C0							.	/
193	C1	.						.	/
194	C2		/					.	/
195	C3	.	/					.	/
196	C4			.				.	/
197	C5	.		.				.	/
198	C6		/	.				.	/
199	C7	.	/	.				.	/
200	C8				/			.	/
201	C9	.			/			.	/
202	CA		/		/			.	/
203	CB	.	/		/			.	/
204	CC			.	/			.	/
205	CD	.		.	/			.	/
206	CE		/	.	/			.	/
207	CF	.	/	.	/			.	/
208	D0					.		.	/
209	D1	.				.		.	/
210	D2		/			.		.	/
211	D3	.	/			.		.	/
212	D4			.		.		.	/
213	D5	.		.		.		.	/
214	D6		/	.		.		.	/
215	D7	.	/	.		.		.	/
216	D8				/	.		.	/
217	D9	.			/	.		.	/
218	DA		/		/	.		.	/
219	DB	.	/		/	.		.	/
220	DC			.	/	.		.	/
221	DD	.		.	/	.		.	/
222	DE		/	.	/	.		.	/
223	DF	.	/	.	/	.		.	/
224	E0						/	.	/
225	E1	.					/	.	/
226	E2		/				/	.	/
227	E3	.	/				/	.	/
228	E4			.			/	.	/
229	E5	.		.			/	.	/
230	E6		/	.			/	.	/
231	E7	.	/	.			/	.	/
232	E8				/		/	.	/
233	E9	.			/		/	.	/
234	EA		/		/		/	.	/
235	EB	.	/		/		/	.	/
236	EC			.	/		/	.	/
237	ED	.		.	/		/	.	/
238	EE		/	.	/		/	.	/
239	EF	.	/	.	/		/	.	/
240	F0					.	/	.	/
241	F1	.				.	/	.	/
242	F2		/			.	/	.	/
243	F3	.	/			.	/	.	/
244	F4			.		.	/	.	/
245	F5	.		.		.	/	.	/
246	F6		/	.		.	/	.	/
247	F7	.	/	.		.	/	.	/
248	F8				/	.	/	.	/
249	F9	.			/	.	/	.	/
250	FA		/		/	.	/	.	/
251	FB	.	/		/	.	/	.	/
252	FC			.	/	.	/	.	/
253	FD	.		.	/	.	/	.	/
254	FE		/	.	/	.	/	.	/
255	FF	.	/	.	/	.	/	.	/

. - Violet
/ - Green
Absence - Black
Combination of Violet and Green - White

Fig. 4. Color bar chart.

sist of 40 memory locations; thus, I added the following statements to the above routine and ran it.

```
55 FOR X = 1 TO 40
60 POKE P + X, 1
65 NEXT X
```

The dot was drawn from left to right and from top to bottom, one line after another until the whole screen filled up with contiguous dots.

I suppose by now you are wondering why only 40 dots came across the screen. I thought the same and continued my experiments and found out that each location on the screen consisted of an 8-bit bar. To clarify, location 8192 displays up to eight bits or dots of light as shown in Figure 2 at location 16436. After some time experimenting, I found out not only did one location display eight bits of light, but also combinations of bits determined what colors were displayed.

Color Bar Chart

I came up with the 8-bit color bar chart of Fig. 4. By poking a 1 into a memory location, a violet dot appeared as shown in the chart. By poking a 2 into a location, a green dot appeared; by poking a 3, a white dot appeared; and so on to 255. By observing the chart I found that bits 1, 3, 5, 7 are violet-displaying bits, and 2, 4, 6, 8 are green-displaying bits. A combination of an even and odd number of bits displays white; zero displays black. These are the four colors that Apple computer said were available in high-resolution graphics.

Application Program

Now that you have the knowledge of high-resolution graphics, create some fun games for the Apple II computer—we need more—or try the paddle drawing routine I brewed up in Fig. 5.

```
10 POKE -16304, 0
20 POKE -16297, 0
25 FOR Y = 8192 TO 16476: POKE Y, 0: NEXT Y
30 LN = PDL (1) - 1
40 A = LN/64
42 X = LN MOD 64
44 B = X/8
46 C = X MOD 8
50 D = (8192 + (A*40) + (B*128) + (C*1024))
55 V = PDL (0)
60 E = D + (V/7)
70 POKE E, 2 ↑ (V MOD 7)
72 IF PEEK (-16287) > 127 THEN POKE E, 0
75 IF PEEK (-16384) > 127 THEN 9000
80 GOTO 30
9000 REM
9010 POKE -16368, 0: GOTO 25
```

Fig. 5. High-resolution drawing routine.

Statements 10 and 20 turn on the high-resolution graphics display. Statement 25 clears the screen to black; you can clear the screen to white by changing the zero to 255. Statement 30 uses paddle 1 as the vertical positioner. Statements 40 through 50 compute the vertical position. Statements 55 and 60 use paddle 0 as the horizontal displacement from the vertical point on the left side of the screen. Statement 70 turns the dots of light on.

As paddle 0 increases or decreases, bits 1, 2, 4, 8 of the color bar are turned on separately. Statement 72 blanks a color bar if the button on paddle 0 is depressed. Statements 75 and 9010 check the keyboard strobe for any key that was pressed and resets the program to clear the screen and start over.

All of my programs can be obtained through me or through Computer Components, 6791 Westminster Avenue, Westminster CA 92683. ■

Reader Service—see page 195

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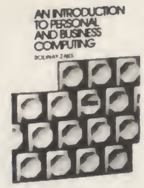

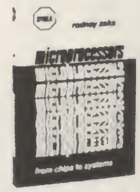

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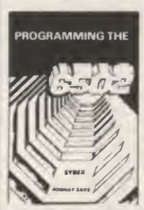

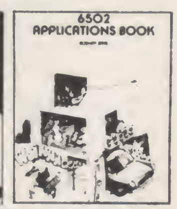

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Beat the Computer

Don't venture to the tables of Las Vegas or Atlantic City without trying this program.

Jerry D. Howard
3955 Swenson #404
Las Vegas NV 89109

People the world over enjoy the game of blackjack, or "21." However, many of them enjoy it less than they could. Why? . . . because they lose. They go to Las Vegas and lose at the tables. They play with their friends and lose hundreds of pennies. They play with their home computer and drop thousands of imaginary dollars, always chalking it up to "bad luck."

Here is a way to stop all that and change your luck quite painlessly! Have your home computer teach you to be a blackjack expert using this computer-assisted instruction (CAI) blackjack strategy program.

The strategy taught by this program is the same as that found in any good book on the game of blackjack. Its development was begun by Baldwin et al[1] and further refined by Professor E. O. Thorp[2] and others[3]. When it is learned and applied, it gives the player basically an even chance at the game of "21," whether against a dealer in Las Vegas or against your TRS-80 or SWTP computer at home. For further information on the game of blackjack, please refer to the reference list at the end of this article.

What the Program Does

First the program goes over with you, point by point, all the fundamentals of blackjack basic strategy. In order to understand this more easily, let's define a few blackjack terms.

Hit—To take another card.

Stand—Staying with the cards you have and letting the dealer take his turn at hitting or standing. (Note: The dealer must take hits until he gets 17 or above.)

Double Down—The act of taking one more card only and, at the same time, doubling your bet. This play is made when you feel one additional card will give you a winning hand.

Pair Splitting—When your first two cards are of the same value, such as two 8s or two 3s, for example, you have the option of "splitting" them and making two hands by taking hits on each member of the pair. Two aces and two 8s are the pairs most often split.

Soft Hand—This is a hand that contains an ace and totals 10 or less without counting the ace, for example, the hand A7, which could consist of an ace and a 7 or an ace and a 3 and a 4. Most people would call this hand "soft 18."

If this terminology is a bit confusing to you, I would suggest that you learn the rules of play from a simple book on blackjack before attempting to learn the playing strategy that the program teaches.

After this review of basic strategy, the program then gives you a *thorough* drill in practically every strategy situation that could come up in the game of blackjack. When you make a mistake it corrects you. If you don't know the correct answer, it tells you. And it gives you compliments for doing a good job!

Sample run.

```
THIS PROGRAM WILL TEACH YOU BLACKJACK STRATEGY.

FIRST A REVIEW OF THE STRATEGY...

WHAT YOU DO DEPENDS ON THE DEALERS UP CARD
 AND ON YOUR HAND (YOUR FIRST 2 CARDS).

WHEN THE DEALER HAS 7,8,9,10,OR ACE SHOWING
 HIT UNTIL YOU GET 17 OR ABOVE.

IF THE DEALER HAS 2,3,4,5,OR 6 UP  YOU
 STAND IF YOU HAVE 13 OR ABOVE.
 HIT 12 IF DEALER HAS 2 OR 3 UP.

 THIS SECTION TELLS YOU WHEN TO DOUBLE DOWN .

 DOUBLE DOWN WHEN YOU HAVE 11  ALWAYS !

DOUBLE WHEN YOU HAVE      & DEALER SHOWS
    10                   ANY CARD EXCEPT 10 OR A
     9                        2 THROUGH 6
     8(EXCEPT 6,2)             5 OR  6
 A2 THROUGH A5                 4,5  OR 6
    A6                        2 THROUGH 6
    A7                        3 THROUGH 6
    A8                              6

TYPE RETURN TO MOVE ON..     ?

NOTE: WHEN YOU CAN'T DOUBLE DOWN ON YOUR 'SOFT'
 HANDS, DO AS FOLLOWS:
 A2,A3,A4,A5,A6    HIT IF YOU CAN'T DOUBLE.
 A7   STAND AGAINST DEALER CARD OF 2,7,8,OR A
 A7   HIT AGAINST DEALERS 9 OR 10
 A8         STAND.

 TYPE RETURN TO MOVE ON..   ?

 THIS SECTION SHOWS YOU WHEN TO SPLIT PAIRS.
```

The program tells you all you need to know to become a better player than over 95 percent of the people who play blackjack in Las Vegas. I know because I've seen them play. Most people can't seem to get themselves to learn a strategy from a book, but a CAI program like this makes it easy.

A full run of the program will take about 20 to 45 minutes, depending on how fast your computer is and how fast and accurate your responses are. When you can go through the whole program with no mistakes, you can consider yourself ready to head for the green felt of Las Vegas or the green screen of an Apple II.

How the Program Works

The first part of the program is quite simple. It reviews the strategy by means of a group of print statements beginning at line 550. There are delays and user "continues" at lines 600, 640, 715, 722 and 745. These are for screen timing and can be removed if you're using a hard-copy terminal.

The second part of the program uses the information contained in all those data statements. The data statements contain four practice tables: A hit/stand table, a double down table, a pair splitting table and a large general practice table. The program reads the player's hand, dealer up card and correct plays in groups of 20, which it then randomizes so the questions are asked in a different order each time the program is run. The player may terminate the drill at any point by typing BYE as the answer to a question. Otherwise, all four tables will be completed . . . a real workout!

The program runs, minus two or three REM statements, on my 16K SWTP 6800 in 8K of user memory. BASIC takes up the other 8K. There are no fancy or "Extended BASIC" statements in the program, so it should be easily adaptable to a wide variety of BASICs. ■

References

1. Roger Baldwin et al, "The Optimum Strategy in Blackjack," J. of the American Statistical Assoc., vol. 51, 1956.
2. Edward O. Thorp, *Beat the Dealer*, Random House, 1966.
3. Lawrence Revere, *Playing Blackjack as a Business,* Lyle Stuart, Inc. (Note: This book is especially recommended for serious blackjack students.)


```
   ALWAYS SPLIT AA AND 88 .

   NEVER SPLIT 44 , 55 , OR 1010
   SPLIT        AGAINST        DEALERS CARD
    22                          3 THROUGH 7
    33                          4 THROUGH 7
    66                          2 THROUGH 6
    77                          2 THROUGH 7
    99                        2 THROUGH 9 (EXCEPT 7)

   TYPE RETURN TO CONTINUE?

   WHEN YOU PLAY BLACKJACK FOLLOW THE ABOVE
    RULES COMPLETELY !  DON'T FOLLOW HUNCHES
  AND NEVER TAKE INSURANCE !

   NOW FOR THE HARD PART...

 ENTER A NUMBER BETWEEN 1 AND 50 ? 15

 THE ANSWERS YOU GIVE ARE AS FOLLOWS:
  H = HIT, S = STAND, D = DOUBLE DOWN,
  P = PAIR SPLIT, T = TELL ME .
 TYPE 'BYE' IF YOU WANT TO STOP.

 YOUR HAND        DEALER SHOWS     YOUR PLAY
 12               6                 ? S
 16               8                 ? H
 15               2                 ? S
 13               3                 ? S
 14               7                 ? H
 16               5                 ? H
 WITH 16 VS 5 YOU S
 16               5                 ? S
 16               2                 ? S
 15               A                 ? H
 16               9                 ? T
 THE ANSWER IS H
 16               9                 ? H
 13               6                 ? S
 A7               A                 ? BYE
 THAT WAS GOOD! IF YOU ARE READY FOR SOME MORE
  TYPE RUN AGAIN....ANYTIME.
```

Program listing.

```
0001 REM *** BLACKJACK BASIC STRATEGY PROGRAM ***
0002 REM WRITTEN BY JERRY HOWARD
0003 REM ****************************************
0004 REM
0007 REM *** HERE ARE ALL THE PRACTICE TABLES :
0008 REM ** THIS DATA IS A BIT OF A DRAG TO TYPE IN BUT
0009 REM SAVES MANY HOURS IN LEARNING THE STRATEGY !
0010 DATA 15,9,H,13,5,S,16,8,H,12,4,S,15,2,S,16,5,S,A7,7,S
0020 DATA 15,A,H,13,6,S,16,2,S,12,5,S,15,8,H,14,5,S,A7,A,S
0030 DATA 16,9,H,14,7,H,16,10,H,12,6,S,15,10,H,13,3,S,A7,8,S
0040 DATA 15,5,S,14,8,H,16,A,H,12,2,H,15,7,H,13,4,S,A7,10,H
0050 DATA 14,10,H,16,6,S,14,5,S,12,3,H,13,A,H,13,2,S,A7,9,H
0060 DATA 14,6,S,13,10,H,16,3,S,16,7,H,14,9,H
0070 DATA 14,6,S,77,10,S,N,N,N
0074 REM ** THAT WAS THE HIT/STAND TABLE.
0075 REM ** NOW THE DOUBLE DOWN TABLE .
0080 DATA 10,4,D,9,7,H,A4,4,D,11,9,D,A2,3,H,
0090 DATA A5,6,D,62,4,H,A7,3,D,11,5,D
0100 DATA 10,5,D,9,8,H,A4,3,H,11,10,D,A2,5,D,A6,6,D
0110 DATA 53,5,D,A7,4,D,11,6,D
0120 DATA 10,6,D,9,3,D,A5,3,H,11,A,D,A2,6,D,
0130 DATA A6,3,D,62,6,H,A7,5,D,11,7,D
0140 DATA 10,7,D,9,4,D,A4,5,D,11,2,D,A3,3,H,A6,4,D,
0150 DATA 53,3,H,A7,6,D,A2,4,D
0160 DAT 10,8,D,9,5,D,A5,4,D,11,3,D,A3,4,D,A6,5,D,62,5,H
0170 DATA A8,3,S,A3,5,D
0180 DATA 10,9,D,9,2,D,A5,5,D,11,4,D,A3,6,D,A6,2,D
0190 DATA 53,6,D,A8,6,D,A4,6,D,N,N,N
0195 REM ** NEXT THE PAIR SPLITTING TABLE.
0200 DATA 99,4,P,44,2,H,77,6,P,66,4,P,22,3,P,33,7,P,99,10,S
0210 DATA 99,5,P,44,3,H,77,7,P,66,5,P,22,4,P,33,8,H,99,A,S
0220 DATA 99,6,P,44,4,H,77,8,H,66,6,P,22,5,P,33,2,H,99,2,P
0230 DATA 99,7,S,44,5,D,77,2,P,66,7,H,22,8,H,33,3,H,99,3,P
0240 DATA 99,8,P,44,6,D,77,3,P,66,2,P,22,7,P,33,4,P,AA,A,P
0250 DATA 99,9,P,88,10,P,77,9,H,66,8,H,22,2,H
0260 DATA 44,7,H,AA,10,P,N,N,N
0265 REM ** NOW A BIG GENERAL PRACTICE TABLE
0270 DATA 12,6,S,53,4,H,53,6,D,53,5,D,A7,10,H,44,7,H,62,6,H
0280 DATA AA,3,P,12,2,H,12,4,S,16,2,S,12,3,H,13,2,S,12,5,S
0290 DATA 14,2,S,A2,4,D,A4,3,H,A2,6,D,A4,5,D,A2,5,D,A2,3,H
0300 DATA 10,9,D,73,3,D,64,10,H,55,2,D,82,4,D,73,8,D,64,5,D
0310 DATA 44,6,D,AA,9,P,AA,10,P,AA,2,P,AA,7,P,AA,8,P,AA,A,P
0320 DATA 13,8,H,13,6,S,15,5,S,13,3,S,13,5,S,14,4,S,14,6,S
0330 DATA A8,5,S,33,8,H,33,3,H,33,5,P,33,7,P,33,2,H,33,4,P
0340 DATA 33,6,P,A6,2,D,A6,6,D,A4,4,D,A6,4,D,A6,5,D,A7,3,D
0350 DATA A7,2,S,44,4,H,62,5,H,44,3,H,44,2,H,88,9,P,44,5,D
0360 DATA 13,4,S,16,5,S,14,3,S,14,5,S,15,2,S,15,4,S,15,6,S
0370 DATA A4,6,D,55,7,D,83,9,D,74,A,D,82,6,D,73,A,H,A4,2,H
0380 DATA 65,7,D,22,4,P,22,6,P,22,8,H,22,5,P,22,3,P,22,7,P
0390 DATA 22,2,H,A8,3,S,A3,5,D,A6,3,D,A8,2,S,A8,4,S,A8,6,D
0400 DATA 15,3,S,66,6,P,66,7,H,88,10,P,66,3,P,66,5,P,66,2,P
0410 DATA 66,4,P,63,4,D,54,8,H,72,3,D,63,5,D,54,2,D,72,7,H
0420 DATA 72,6,D,16,8,H,15,7,H,14,8,H,14,7,H,15,8,H,A9,4,S
0430 DATA 53,3,H,A3,3,H,A5,6,D,A5,5,D,A3,4,D,A3,6,D,16,7,H
0440 DATA A5,4,D,15,10,H,16,3,S,16,10,H,16,6,S,14,10,H,74,2,D
450 DATA 77,2,P,77,4,P,77,6,P,A7,A,S,77,8,H,77,3,P,77,5,P
0460 DATA 99,5,P,83,10,D,13,A,H,15,9,H,16,A,H,16,9,H,A5,3,H
0470 DATA 15,A,H,14,9,H,74,5,D,65,4,D,92,6,D,83,3,D,16,4,S
0480 DATA 92,8,D,99,7,S,99,A,S,99,2,P,99,4,P,99,6,P,99,3,P
0490 DATA A9,5,S,A7,6,D,A9,3,S,A7,4,D,A9,6,S
0495 DATA 83,A,D
0500 DATA A7,5,D,14,A,H,999,999,999
0540 REM ** FLOW OF THE PROGRAM STARTS HERE.
0550 PRINT ' THIS PROGRAM WILL TEACH YOU BLACKJACK STRATEGY.'
0555 PRINT
0560 PRINT ' FIRST A REVIEW OF THE STRATEGY...'
0565 PRINT
0570 PRINT :PRINT' WHAT YOU DO DEPENDS ON THE DEALERS UP CARD'
0575 PRINT '  AND ON YOUR HAND (YOUR FIRST 2 CARDS).'
0577 PRINT
0580 PRINT '  WHEN THE DEALER HAS 7,8,9,10,OR ACE SHOWING'
0590 PRINT '  HIT UNTIL YOU GET 17 OR ABOVE.' :PRINT
0598 REM ** A LITTLE DELAY HERE.
0600 FOR I=1TO 500:NEXT I
0610 PRINT ' IF THE DEALER HAS 2,3,4,5,OR 6 UP  YOU '
0620 PRINT '  STAND IF YOU HAVE 13 OR ABOVE. '
0630 PRINT '  HIT 12 IF DEALER HAS 2 OR 3 UP. ' :PRINT
0640 FOR I=1 TO 500:NEXT I
0650 PRINT '  THIS SECTION TELLS YOU WHEN TO DOUBLE DOWN .'
0660 PRINT :PRINT'  DOUBLE DOWN WHEN YOU HAVE 11  ALWAYS! '
0670 PRINT :PRINT' DOUBLE WHEN YOU HAVE      & DEALER SHOWS  '
0680 PRINT '     10                    ANY CARD EXCEPT 10 OR A'
0690 PRINT '      9                           2 THROUGH 6 '
0700 PRINT '      8(EXCEPT 6,2)                5 OR  6 '
0705 PRINT '  A2 THROUGH A5                    4,5  OR 6 '
0710 PRINT '     A6                           2 THROUGH 6 '
0712 PRINT '     A7                           3 THROUGH 6 '
0714 PRINT '     A8                                 6 '
0715 PRINT :PRINT' TYPE RETURN TO MOVE ON';:INPUT A$
0716 PRINT :PRINT'NOTE: WHEN YOU CAN'T DOUBLE DOWN ON YOUR 'SOFT''
0717 PRINT '  HANDS, DO AS FOLLOWS:'
0718 PRINT '  A2,A3,A4,A5,A6    HIT IF YOU CAN'T DOUBLE.'
0719 PRINT '  A7   STAND AGAINST DEALER CARD OF 2,7,8,OR A '
0720 PRINT '  A7   HIT AGAINST DEALERS 9 OR 10 '
0721 PRINT '  A8           STAND.'
0722 PRINT :PRINT'  TYPE RETURN TO MOVE ON..';:INPUT A$
0724 PRINT :PRINT'  THIS SECTION SHOWS YOU WHEN TO SPLIT PAIRS.'
0725 PRINT :PRINT'  ALWAYS SPLIT AA AND 88 .'
0727 PRINT :PRINT'  NEVER SPLIT 44 , 55 , OR 1010 '
0730 PRINT '  SPLIT        AGAINST        DEALERS CARD '
0732 PRINT '   22                          3 THROUGH 7'
0735 PRINT '   33                          4 THROUGH 7'
0737 PRINT '   66                          2 THROUGH 6'
0740 PRINT '   77                          2 THROUGH 7'
0742 PRINT '   99                        2 THROUGH 9 (EXCEPT 7)'
0745 PRINT :PRINT'  TYPE RETURN TO CONTINUE';:INPUT A$
0750 PRINT :PRINT'  WHEN YOU PLAY BLACKJACK FOLLOW THE ABOVE'
0755 PRINT '   RULES COMPLETELY !  DON'T FOLLOW HUNCHES '
0760 PRINT ' AND NEVER TAKE INSURANCE !'
0763 FOR I = 1 TO 500:NEXT I
0765 PRINT :PRINT'  NOW FOR THE HARD PART...'
0810 PRINT :PRINT 'ENTER A NUMBER BETWEEN 1 AND 50 ';
0820 INPUT R
0825 REM ** R IS USED TO INITIALIZE THE RANDOM # GENERATOR.
0880 PRINT :PRINT 'THE ANSWERS YOU GIVE ARE AS FOLLOWS:'
```

```
0890 PRINT ' H = HIT, S = STAND, D = DOUBLE DOWN,'
0900 PRINT ' P = PAIR SPLIT, T = TELL ME .'
2000 REM **RANDOMIZE INDEX**
2001 FOR I=1TOR:Z=RND(0):NEXT I
2010 DIM X(20),A$(20),B$(20),C$(20)
2020 FOR I=1TO20:X(I)=I:NEXT I
2025 REM ** THE QUESTIONS ARE ASKED IN GROUPS OF 20 ,AND
2026 REM    RANDOMIZED WITHIN THAT GROUP SO THE PRACTICE
2027 REM    IS DIFFERENT EVERY RUN.
2030 FOR J=1TO19
2040 Y=INT(RND(0)*(21-J))+J
2050 T=X(J):X(J)=X(Y):X(Y)=T
2060 NEXT J
2070 PRINT 'TYPE 'BYE' IF YOU WANT TO STOP.'
2080 PRINT :PRINT
2090 PRINT 'YOUR HAND','DEALER SHOWS','YOUR PLAY'
2500 FOR L=1 TO 20
2502 REM ** A$(L) IS THE PLAYERS HAND.
2503 REM ** B$(L) IS THE DEALERS UP CARD.
2504 REM ** C$(L) IS THE CORRECT PLAY.
2510 READ A$(L),B$(L),C$(L)
2519 REM ** COMMING TO THE END OF THIS TABLE  ?
2520 IF A$(L)='N' THEN M=L-1 :GOTO 6000
2529 REM ** END OF ALL THE TABLES ?
2530 IF A$(L)='999' THEN 6000
2560 NEXT L
3000 FOR I=1TO 20
3010 M=X(I)
3040 PRINT A$(M),B$(M),' ';:INPUT Z$
3050 IF Z$='BYE' THEN 9000
3060 IF Z$='T' THEN 3100
3070 IF Z$=C$(M) THEN 3120
3080 PRINT 'WITH ';A$(M);' VS ';B$(M);' YOU ';C$(M)
3090 GOTO 3040
3099 REM ** TELL HIM WHAT THE ANSWER IS.
3100 PRINT 'THE ANSWER IS ';C$(M)
3110 GOTO 3040
3120 NEXT I
3130 GOTO 2500
6000 FOR J=1TOM
6005 IF A$(J)='999' THEN 9000
6010 PRINT A$(J),B$(J),' ';:INPUT Z$
6020 IF Z$ ='BYE' THEN 9000
6030 IF Z$ = 'T' THEN 6070
6040 IF Z$ = C$(J) THEN 6090
6050 PRINT 'NOPE, ITS ';C$(J)
6060 GOTO 6010
6070 PRINT 'THE ANSWER IS  ';C$(J)
6080 GOTO 6010
6090 NEXT J
6100 PRINT 'VERY GOOD...ON TO THE NEXT TABLE.'
6110 PRINT : GOTO 2090
9000 PRINT 'THAT WAS GOOD! IF YOU ARE READY FOR SOME MORE'
9010 PRINT ' TYPE RUN AGAIN....ANYTIME.'
9999 END
```


Reader Service—see page 195

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Put Your PET on the Bus

PET, meet Betsi. You two were made for each other.

Michael Tulloch
103 White Cr.
Niceville FL 32578

One of the shortcomings of the new "appliance" computers is their lack of expandability. Yes, I know Radio Shack and Commodore will have lots of things. Still, it's going to be a while before either one has all the goodies already available for the S-100 bus. I doubt they'll ever have all of them. Regardless of the superior new bus you have, the S-100 is the standard hobby bus.

Now you can have the best of both worlds. You can buy a ready-to-run appliance computer (PET) and still have an expandable hobby computer. All you need is the Betsi (Commodore made Forethought Products, maker of the Betsi, stop using Petsi). The Betsi is a brother to Kimsi. It makes possible the addition of S-100 boards to your PET.

I'm going to tell you why you should get one for your PET, what it costs, what it is and how it works. I'll review building the kit version, but Betsi is also available assembled. I'll also discuss some of Betsi's limitations.

Betsi Board Features

Why should you buy a Betsi? Since it isn't made by Commodore, Betsi physically, not electrically, interferes with Commodore's proposed memory expansion. Until Betsi gets a case, its appearance warms the heart of only an avid hobbyist. It requires an external power supply.

So why buy a Betsi? . . . because it's beautiful. It opens up the world of "real" hobby computing. It gives the PET owner access to most of the myriad S-100 boards. It sets you free!

One good reason for buying Betsi is availability. Commodore has a memory expansion "in work"; Forethought Products is shipping now. MOS Technology RAMs are hard to get; S.D. Sales (or Godbout, etc.) memory boards can be bought over-the-counter at computer stores everywhere.

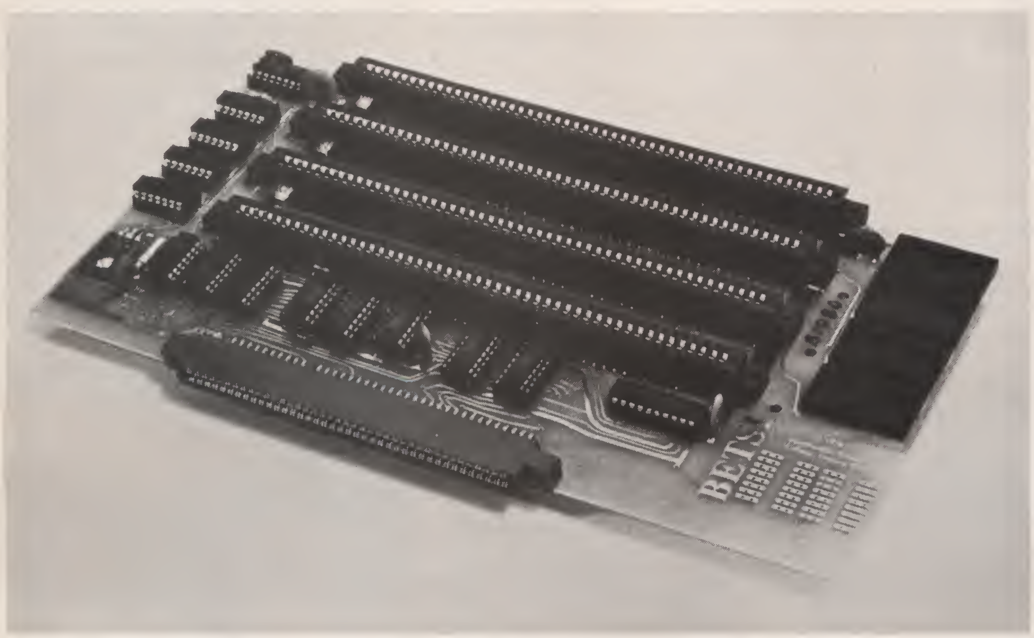
Perhaps the best reason to buy Betsi is its low cost. Commodore is selling their 4K × 1 RAMs for $30 each. You'll need eight for 4K ($240) and a (nonexistent) board. That compares with an S.D. Sales Expandoram with 8K for $159. Since Betsi is selling for $119, you can buy both boards for $278. Additional 4K blocks are $54 with Betsi/Expandoram, while each 4K block is still $240 from Commodore. Thus you initially save over $200 on an 8K memory, $186 on each 4K expansion, while acquiring a bunch of extra features. Not a bad deal at all.

Betsi is a single circuit board. It has 14 ICs (all with sockets), four sockets for Intel 2716 PROMs and room for four S-100 edge connectors, with one edge connector furnished. Betsi is also the same size and shape as a standard S-100 board. It even has the S-100 card edge. Thus, it can be plugged into an S-100 motherboard in place of a CPU board. Forethought is working on a PET-compatible case. And, I bet, they're working on firmware to plug into those PROM sockets.

When I opened my Betsi box I found three things: components, a circuit board and documentation. Components came packed in two plastic bags. ICs and sockets were in one bag. Hardware, resistors and PROM sockets came in the other plastic bag. The ICs and their sockets arrived in good shape.

The PROM sockets didn't fare so well. All four sockets had been squashed. Three sockets were salvageable. The fourth socket had broken pins. They sent me a replacement socket, which was also squashed, even though it was packaged in Styrofoam.

The circuit board is complete with plated-through holes, solder mask and tinned traces. Quality here certainly contributed to easy assembly. Solder bridges with these parts are hard to achieve, even on pur-



Betsi assembled. *(Courtesy Forethought)*

The Betsi kit. Here's all it takes to put your PET on the S-100 bus.

pose. Parts layout is logical and simple. All ICs have pin #1 toward the nearest board edge. It's easy to check.

Documentation is outstanding. Power supply suggestions and a compatibility list were supplied with the 26-page "assembly/operating manual." The manual has several features of note. Background on tools and techniques should see even the most rank beginner through. Absolutely everything of importance from soldering iron tips to clothes is covered. Assembly instructions may not be up to Heathkit standards, but they come close.

My only complaint here is that the board doesn't have pin 1 identified for either the ICs or the edge connector. Pictorial views show the chips with notches but not pin numbers. In the parts list several different pin ID schemes are shown. But you still have to mentally transfer position from parts list to pictorial, then to board. No mention was made of all the ICs being mounted with pin 1 toward the board's outer edge. I marked my board with a felt-tip pen.

The PET Bus

Betsi's operation is relatively simple. However, some of these operations are not obvious. Commodore's PET has a bus they call "memory expansion," which is a bit different from the S-100 or SS-50 type of bus. Commodore is oriented more toward a specific device rather than a general-purpose bus. It has most of the things you need, but it isn't exactly versatile. It is intended only as memory expansion. Commodore plans all other devices around the IEEE bus port.

The PET bus is brought out as a 40-position two-sided card edge. All the top 40 pins are ground. (Why? Only Commodore knows.) The lower pins are assigned as shown in Table 1. There are 12 address lines (A0-A11). That only accounts for 4K of addresses. So, there are also ten select lines (Sel 1-Sel B, no Sel 8). Thus 40K of external addressing is provided in 4K blocks. This addressing scheme is quite different from the S-100's 16 address lines that allow addressing to 65K.

There are eight bidirectional data lines (DB0-DB7). This follows the 6502 architecture, which uses bidirectional data lines rather than the S-100 bus, which uses separate input and output data lines.

In addition to the address and data lines, PET has only four other signals brought out. These are: Reset (RES), Interrupt request (IRQ.), Read/Write (R/W) and one clock signal (BØ).

S-100 Conversion

As a partial explanation of how Betsi uses these signals to generate S-100-compatible signals, I'll consider the last four signals mentioned above. For example, Ø2 comes straight through to S-100 pin 24 as Ø2. Ø2 is also used to trigger half of a 74123, which in turn provides PSYNC. PSYNCH and any of the ten PET Sel lines combine to provide RFSH. The Betsi-generated I/O line is ORed with R/W to provide SMEMR. R/W is inverted to provide SWO. And so on. Suffice it to say that R/W,Ø2 and the address lines are used to generate SMEMR, SWO, SINP, SOUT, MWRITE, PWR, PDBN and Ø1. PINT is IRQ. EXT CLR is tied high while PWAIT, PROT and UNPROT are all tied low.

PET's select lines are used to generate internal address lines A12-A15. Select lines 9, A and B are used to address the Betsi's on-board PROM sockets as well. These internal address lines are combined with the PET address lines to generate S-100 address lines A0-A15. Betsi's internal I/O line strobes a 74LS157 to clock out the A8-A15 part of the address.

The data bus is simply buffered with an 81LS95 (or 81LS97) to provide S-100 DO0-DO7. The S-100 DI lines are directly connected to the PET data lines. Table 2 lists the S-100 lines and whether or not Betsi uses them. The table is taken directly from the Betsi manual, which goes into more descriptive detail.

Compatibility

Since the PET uses a 6502 rather than one of the 8080 types of microprocessors, there are some things even Betsi can't do. As a result, not all S-100 boards will work. Forethought has a good start on which S-100 boards work with Betsi and which don't work. In fact, if you want to go S-100, you might be better off with PET and Betsi. With an S-100 computer you may not know which boards don't work together until you get home. You get a list with Betsi (see Table 3).

Most of the boards that are in-

1. A0
2. A1
3. A2
4. A3
5. A4
6. A5
7. A6
8. A7
9. A8
10. A9
11. A10
12. A11
13. NC
14. NC
15. NC
16. $\overline{SEL\ 1}$
17. $\overline{SEL\ 2}$
18. $\overline{SEL\ 3}$
19. $\overline{SEL\ 4}$
20. $\overline{SEL\ 5}$
21. $\overline{SEL\ 6}$
22. $\overline{SEL\ 7}$
23. $\overline{SEL\ 9}$
24. $\overline{SEL\ A}$
25. $\overline{SEL\ B}$
26. NC
27. $\overline{RES}$
28. $\overline{IRQ.}$
29. $\overline{BØ2}$
30. $\overline{R/W}$
31. NC
32. NC
33. BD0
34. BD1
35. BD2
36. BD3
37. BD4
38. BD5
39. BD6
40. BD7

Table 1. Lower pin assignments.

PET, Betsi, Expandoram and power supply.

compatible with PET/Betsi require the CPU to stop. Some want PET to stop during a programming cycle, while doing D/A conversion or during onboard refresh. PET won't wait. Thus, most dynamic RAM boards are ruled out. For me, the worst-case incompatibility is that Betsi can't use the Cromemco TV Dazzler. If only Commodore had brought out the READY line.

On the more pleasant side, there are probably more boards that are compatible than are not. All static RAM boards should work. Some boards that are believed to be compatible haven't been tested. You can help out by writing Forethought after you try a new board. Some of those I'd like to know about are the speech generation and recognition boards, the video boards and the graphics boards.

Another limitation is that Betsi doesn't have an enable function. It would be great if Betsi could be switched off the PET bus and disabled. A microprocessor board could then be used with Betsi. Currently, Betsi acts like an S-100 processor board—without a hold. Oh, well, that gives me something to do. Betsi has a small kludge area.

Building the Kit

Assembling Betsi was easy. Even solder is included in the kit. It took me four leisurely hours to do all the soldering. The board was well tinned and not oxidized so soldering was rapid. I didn't even clean the board.

My only assembly complaints are: (1) I had to drill out one filled hole, (2) the high-reliability sockets required lots of force to seat the ICs, (3) one 74LS157N was internally shorted, (4) one 24-pin socket had broken pins. It took me less than an hour to troubleshoot the board . . . five hours in all, an easy evening's work.

One difference between the kit I assembled and the one you'll buy is the Betsi-to-PET edge connector. Betsi is designed to use an 80-pin, 40 position, .1 inch spaced, right angle edge connector. Two suppliers had been unable to supply Forethought these connectors when I got the kit. Forethought was holding shipment until these connectors came in. In order to complete the article, I talked

Betsi's S-100 Bus
* = not used
L = tied low
H = tied high

	PIN	SYMBOL
	1	+8V
	2	+16V
*	3	XRDY
*	4	VI0
*	5	VI1
*	6	VI2
*	7	VI3
*	8	VI4
*	9	VI5
*	10	VI6
*	11	VI7
	12-17	UNUSED
*	18	STATUS DSBL
*	19	CC DSBL
L	20	UNPROT
*	21	SS
*	22	ADDR DSBL
*	23	DO DSBL
	24	Ø2
	25	Ø1
*	26	PHLDA
L	27	PWAIT
*	28	PINTE
	29	A5
	30	A4
	31	A3
	32	A15
	33	A12
	34	A9
	35	DO1
	36	DO0
	37	A10
	38	DO4
	39	DO5
	40	DO6
	41	DI2
	42	DI3
	43	DI7
*	44	SMI
	45	SOUT
	46	SINP
	47	SMEMR
*	48	SHLTA
*	49	CLOCK
	50	GND
	51	+8V
	52	−16V
*	53	SSW DSB
H	54	EXT CLR
	55-66	NOT USED
	66	RFSH
*	67	PHANTOM
	68	MWRITE
*	69	PS
L	70	PROT
*	71	RUN
*	72	PRDY
	73	PINT
*	74	PHOLD
	75	PRESET
	76	PSYNC
	77	PWR
	78	PDBIN
	79	A0
	80	A1
	81	A2
	82	A6
	83	A7
	84	A8
	85	A13
	86	A14
	87	A11
	88	DO2
	89	DO3
	90	DO7
	91	DI4
	92	DI5
	93	DI6
	94	DI1
	95	DI0
*	96	SINTA
	97	SWO
*	98	SSTACK
	99	POC
	100	GND

Table 2.

S-100 boards *known* to be compatible with Betsi

Advanced Microcomputer Products—LOGOS I 8K RAM
Artec Electronics—8 to 32K static RAM
Base 2—8K RAM, 16K RAM
Cybercom (Solid State Music)—MB6A (8K static RAM)
DRC—8K Static RAM
Dynabyte—16K RAM
Godbout Electronics—Econoram II (8K RAM)
Imsai—RAM 4A-4 (4K static RAM)
Industrial Micro Systems (IMS)—8K Static RAM
Ithaca Audio—8K RAM
Kent-Moore—4K and 8K RAM
Kent-Moore—VDM I and VDM II (video boards)
Micro Applications—4K Static RAM
Mullen—Relay/Opto-isolator Control Board
Problem Solvers Systems—8K RAM
Processor Technology—8KRA (8K static RAM)
S.D. Sales—4K RAM
S.D. Sales—Expandable EPROM (16K of 2708 or 32K of 2716)
S.D. Sales—Expandoram (8 to 32K dynamic RAM board)
Seals—4K RAM and 8K RAM
Tarbell Electronics—Cassette Interface Board
Vandenberg Data Products—16K Static RAM
Wameco—8K Static RAM

S-100 boards *believed* to be compatible with Betsi

All static RAM boards on the market
Computalker Consultants—Computalker CT-1 Speech Synthesizer
DC Hayes Associates—80-103A Modem board
Godbout—Econoram IV (16K RAM)
Heuristics Inc.—Speechlab (speech recognition board)
Imsai—PIO (parallel I/O board)
Imsai—PROM 4 (for reading 1702A PROMs)
Ithaca Audio—16K X 8 ROM (for reading 2708 PROMs)
Matrox—ALT-2480 (24 char X 80 line video board)
Matrox—ALT-256**2 (256 X 256 video graphics board)
Szerlip Enterprises—THE PROM SETTER (1702A/2704/2708 programmer)
Wameco—RTC1 (Real Time Clock)

S-100 boards *not compatible* with Betsi

Most dynamic RAM boards #3
Cromemco—8K Bytesaver (will read but not program PROMs) #1
Cromemco—D+7AIO (D/A, A/D board) #2
Cromemco—TV Dazzler (color video board)
Imsai—PIC8 (Priority Interrupt Card)
XYBEK—Prammer (PROM programmer) #1

Notes
#1 Tries to stop CPU in write cycle during programming cycle
#2 Tries to stop CPU in write cycle while doing D/A conversion
#3 Tries to stop CPU in write cycle if accessed during refresh

Table 3. Betsi S-100 board compatibility list.

Forethought into shipping me a kit.

Luckily, I had a wire-wrap connector that met all the above requirements except that it had straight pins. Since only a few of the top pins (all ground) needed to be bent, I bent the pins with long-nose pliers. It worked well.

I wish I could recommend this solution to everyone, but I waited three months to get this connector from the manufacturer. I understand that Forethought now has a supply of the correct connector and is shipping Betsis.

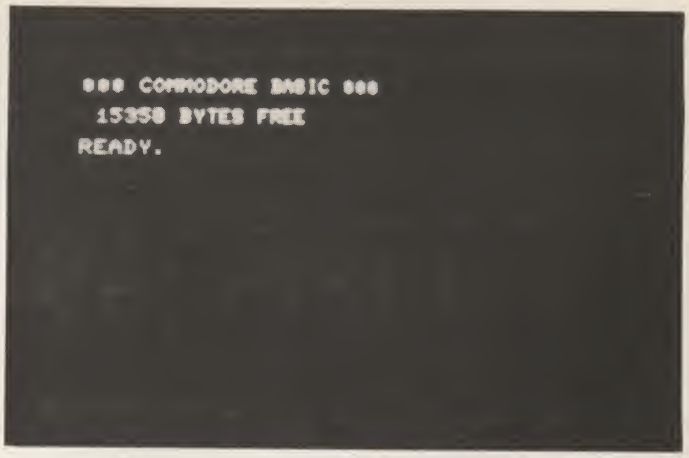
I also have a small complaint about the power transformers recommended for a power supply. They run *hot!* I wonder how long they'll last? Betsi and the Expandoram don't draw anywhere close to the transformers' ratings. Don't try! In any case, Forethought plans to have a power supply available that will fit into their planned case. But don't wait, building an S-100 power supply isn't that hard.

In all, the kit is easy to build and has good enough instructions to be a first-time project for the beginning kit-builder. However, better technical description of the circuit would help if troubleshooting were ever necessary.

If you use the S.D. Sales Expandoram memory board (I highly recommend it), there is one thing to note. Forethought includes a page in their manual explaining how to modify the RAM board for Betsi (this mod is similar to the mod necessary to use the RAM with a Z-80 CPU). This explanation may be misunderstood.

If you get a Revision A board (marked REV A on the printed circuit board), you should jumper IC19 socket pins 8 and 9 together *on the board*, not the IC pins. Remove IC19 and bend pins 8 and 9 so they don't contact the socket. The instructions sound as if the IC is jumpered.

The schematic for the REV B Expandoram board indicates that S.D. Sales has included an external jumper where needed. The new board, now in production, has a bunch of jumper options that should accommodate everyone, including Betsi.



Turn on Betsi, turn on PET. How sweet it is!

Fortunately, most S-100 boards are directly plug-in, no mods, compatible with Betsi. All static RAM boards are compatible. You just pick up a board at your local computer store (e.g., Godbout's Econoram II at $155 assembled and tested), plug it in and watch for those new, bigger, BYTES FREE to appear at power-up. It's great!

Now that Betsi has put my PET on the bus, I'm going to get a case, a floppy disk, a modem, another video output, more memory, verbal I/O and a printer. Then I'll write an operating system for those PROM sockets. All of this is possible because of Betsi. And Betsi works great. Look out, Commodore, here comes Forethought. Look out, Z-80, here comes PET. ■

Reader Service—see page 195

Robert J. Stetson
Memorex Corporation

Build Your Own TTL Diagnostic Aid

Is your circuit sick? If so, this is just what the doctor ordered.

How many times have you scoped a chip or motherboard connection but couldn't quite see the pulse? Have you ever wondered whether an expected pulse had already occurred but you missed it? Isn't it frustrating trying to see a pulse in the nanosecond range when your scope isn't quite up to it?

I've eliminated these problems with a new device that you can build for less than $100. Although it won't give you pulse duration, it will tell you whether or not a pulse has occurred. TTL problems are almost always caused by pulses not being gated through a defective chip, as opposed to timing difficulties.

Unit Description

This unit is more than just a modified chip monitor; it features an external probe for use where chip clips can't go. A selector switch allows the user to select the mode and slope, while a set of hexadecimal address switches is used for the internal probe. The selectable internal probe can monitor any one of the 16 pins of the chip, on command, electronically.

In practice, the unit is easy to use. The simultaneously displayed logical condition of all 16 pins tells the user at a glance where logic problems are originating. Mine has spoiled me to the point where the scope sits idle while the diagnostic monitor zeroes in on defective chips quickly and with accuracy.

The narrowest pulses are snagged and flagged with the internal and external logic probe. For suspected undesired and intermittent noise pulses, set up the unit as a trap, and it will set the probe memory latch (Fig. 1) when the spike is detected.

If you really want super performance, use 74LS00 series chips, and your diagnostic monitor will run rings around just about any scope.

Overall view of the completed unit.

Theory of Operation

A glance at the block diagram (Fig. 2) gives a good overall view of the unit layout. This drawing coordinates the interconnection of Figs. 1, 3, 4 and 5.

Figs. 3 and 4 are the I/O gating and control section. A common 16-pin chip clip is connected by a ribbon cable to the inputs, pin 1 through pin 16. When wiring the 16-pin chip clip, make sure that the dot on the clip is wired to pin 1.

Each input imposes a loading factor of only one TTL load per input pin. Even chips that are loaded to the limit of their fanout can generally handle more than their rating. I have never encountered a situation where I have overloaded a chip while using this device.

This minimal loading is accomplished by using 7404 hex inverters to monitor the test clip pins. The output of the first I/O gating inverter is connected to a 7402 gate, as well as the input of a 7404. Two stages of additional 7404 inverters are needed to restore the signal to the proper polarity to light the LED when the input pin is high. The signals on the input pins, therefore, illuminate LEDs 1

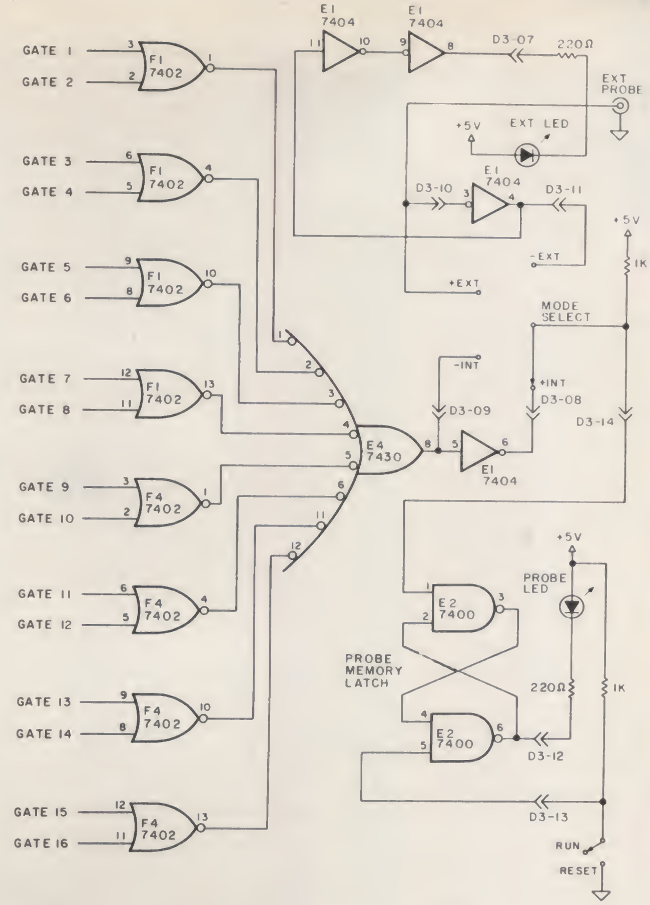


Fig. 1. Probe/mode select.

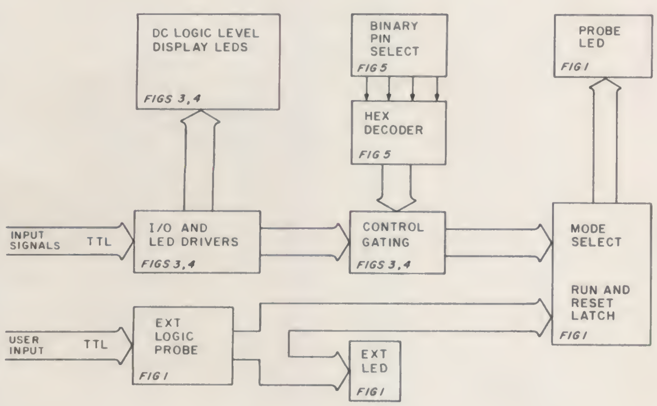
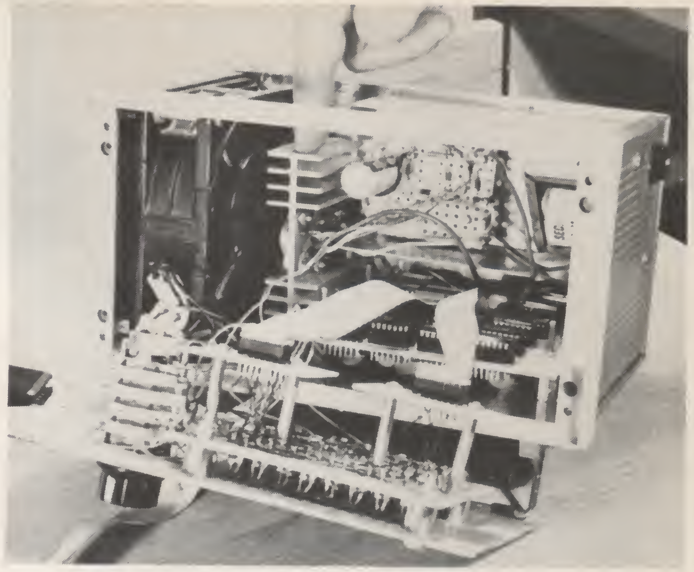


Fig. 2. Block diagram.



The LM309K regulator module is mounted on the same heat sink with the 2N3055.

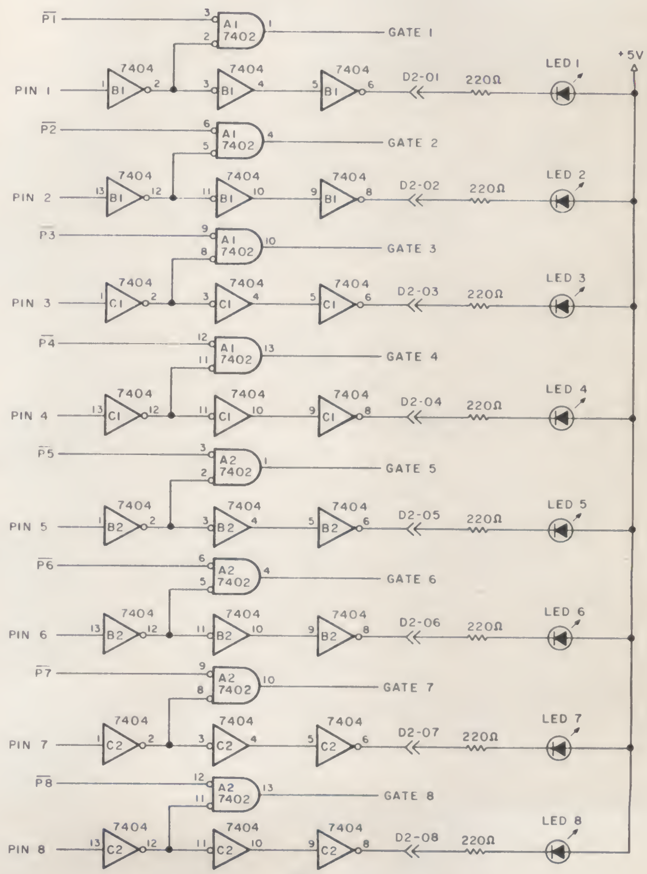


Fig. 3. I/O gating and control section.

through 16 according to the logic level of each respective pin.

LEDs 1 through 16 are arranged on the control panel as shown in Fig. 6 to give a good simultaneous visual display of the pins' dc logic levels. While watching the dc logic levels, you may wonder whether or not you're gating that 800 nanosecond pulse through to, say, pin 5.

Fig. 5 shows the hexadecimal decoder for the internal logic probe. This internal probe monitors any pin you want without additionally increasing the loading on the pin being monitored.

To monitor pin 5, set the bit 1 switch to a logic "1," bit 2 to a logic "0," bit 3 to a logic "1" and bit 4 to a logic "0." With the switches set for a binary 5, the hex decoder will have a low on pin 6 of D4. This is the output for $\overline{P5}$.

Fig. 3 shows $\overline{P5}$ as being NANDed with the inverted input signal from pin 5. The result is that the signal gate 5 follows pin 5. Gate 5 goes to Fig. 1, where it is ORed through a 7402 and a 7430 to the mode select switch.

If pin 5 is normally high and the pulse goes to ground, the mode select switch should be set on −INT (negative pulse, internal probe). Reset the probe LED and return the switch to RUN. If a pulse is detected on pin 5, the probe LED will light and stay lit until it is reset. If pin

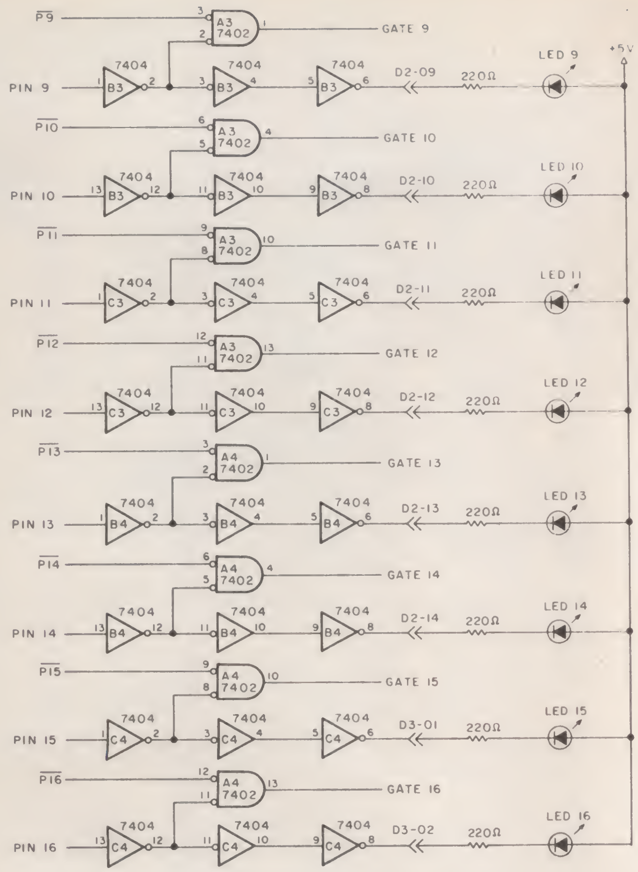


Fig. 4. I/O gating and control section.

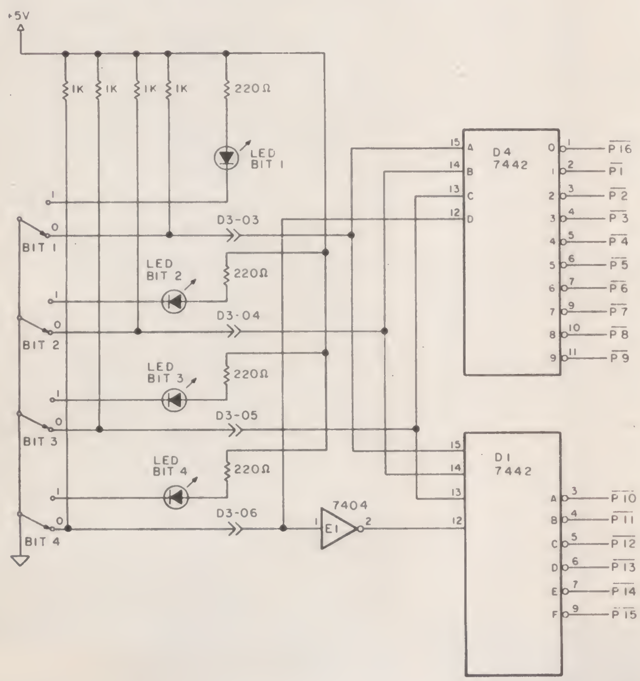


Fig. 5. Hexadecimal decoder (probe addressing).

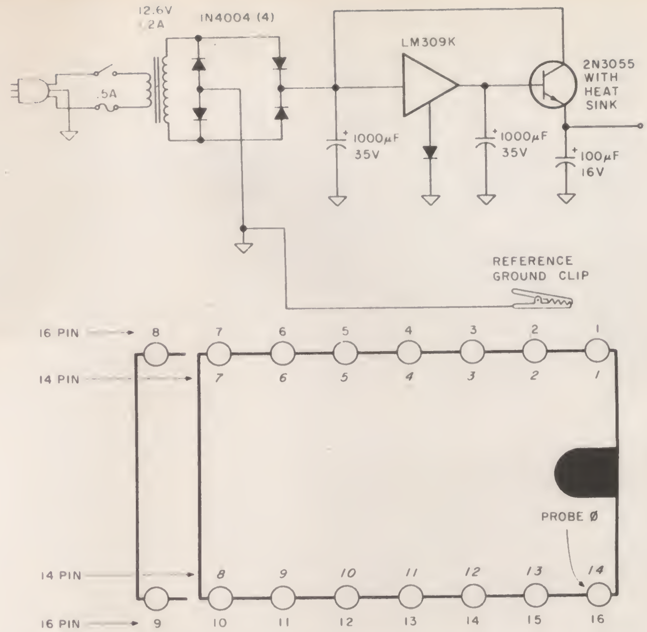


Fig. 6. Power supply. Control panel LED layout.

5 is low, the mode select switch should be set to +INT for a positive pulse.

An external logic probe is provided for probing around the motherboard. The probe on my unit is a length of coaxial cable with the ground shield tied to logic ground. The shield ends at the logic probe, which I made from a sleeve and a red push-type clip, similar to the push clip on a Tektronix scope probe. A black banana jack is used to provide a separate ground return (or reference ground) for the signals. It too uses a push-type spring clip to provide a good connection.

The power supply in Fig. 6 is both simple and effective. The LM309K regulator module is mounted on the same heat sink with the driver transistor (2N3055). Note that the regulator module is used here as a reference for the power transistor and carries very little of its rated load. This ensures greater dependability from the power supply, at little added cost.

I used a muffin fan to cool the unit; however, the unit doesn't really require a cooling fan. This was another addition that improved the reliability of the unit. Even under the photography lighting (90 to 100 degrees F), the cabinet felt cool to the touch due to the amount of air moving through the unit.

The logic board layout is shown in Fig. 7. The connections D2-01 through D2-14 and D3-01 through D3-14 are two 14-pin chip sockets. Ribbon cables are used to interconnect the display board and the logic board. The ON/OFF switch occupies a position on the mode select switch, which has three unused wafers. This switch was selected because it was on hand in my parts cabinet.

How to Operate the Unit

When setting up the unit, make sure the ground reference clip is securely connected to a dc logic point in the unit under test.

A note of caution: The logic probe and chip clip are to be used on TTL logic level signals only. Do not use these on any type CMOS, ECL or other logic families which travel above +5 volts or below ground potential.

The loading factor is 1 TTL gate per pin on the 16-pin connector and 1 TTL gate on the external logic probe. These loading factors are not affected by the load/slope switch or the internal logic probe address switches, as the inputs are each isolated by one stage of TTL input driver.

When the 16-pin chip clip is placed on a 14-pin chip, make sure the dot on the clip is on pin one and that the two unused pins are 8 and 9. If the pin for Vcc (+5), as well as the pin for GROUND, is dark, then the chip is not being provided with power.

Inputs that are not used will float high, but, if you monitor these, they will pulse low while the test clip is on the chip, due to the capacitance between adjacent leads in the ribbon cable

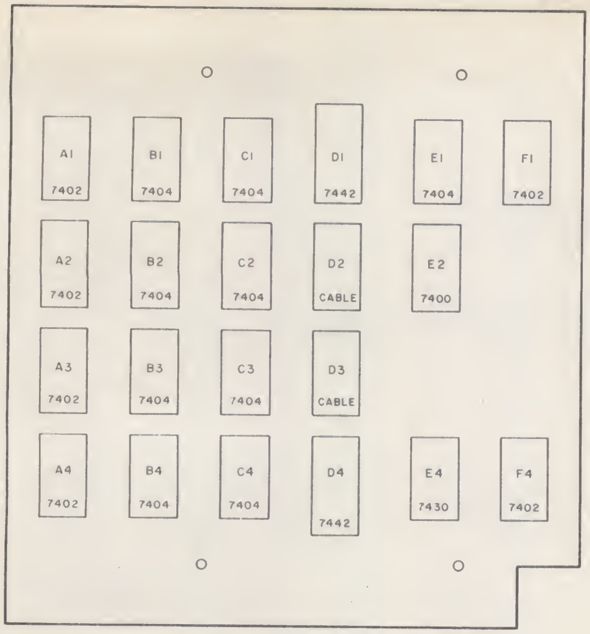
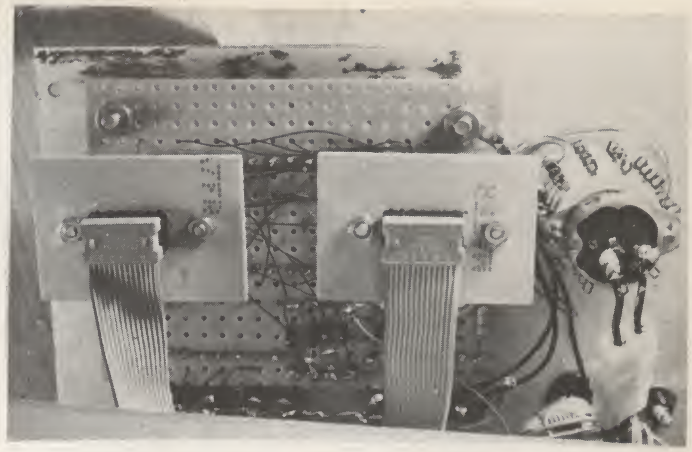


Fig. 7. PC board layout with chip locations.



Ribbon cables are used to interconnect the display and logic boards.

(out to the test clip). Normally, this will not affect the operation of the circuit; however, if you keep getting probe hits while monitoring unused pins, it is normal and not a chip or unit defect.

My unit has a capacitor (.01 uF) from the +5 V to ground on every chip to bypass noise; it does not have as much sensitivity to hits on floating pins as when it was first tested. The bypass filtering eliminates a lot of crosstalk from the ribbon cable to the test clip. A good rule of thumb to remember here is that the better you bypass the supply voltage to your logic, the truer your indications will be.

The pin LEDs are arranged on the control panel in a pattern shown in Fig. 6, according to pin number and location. The dc status as well as most logic changes may be viewed directly on this 16-LED array. To use the internal probe, switch the selector to +INT or −INT according to the polarity of the incoming signal *pulse*. +INT indicates that the polarity of the incoming pulse is positive and that the logic level is normally at ground potential. −INT indicates just the opposite.

To address a pin with the internal logic probe, use the four binary bit switches in Fig. 5 and Table 1. Notice that the internal logic probe is addressed according to the pin number on the chip clip and not the chip. Pin 13 of a 14-pin chip is addressed as pin 15, not pin 13. Note also that address "0000" is reserved for addressing pin 16 on the chip clip.

BIT SWITCHES B4 B3 B2 B1	14 PIN CHIP	16 PIN CHIP
0 0 0 1	1	1
0 0 1 0	2	2
0 0 1 1	3	3
0 1 0 0	4	4
0 1 0 1	5	5
0 1 1 0	6	6
0 1 1 1	7	7
1 0 0 0	NOT USED	8
1 0 0 1	NOT USED	9
1 0 1 0	8	10
1 0 1 1	9	11
1 1 0 0	10	12
1 1 0 1	11	13
1 1 1 0	12	14
1 1 1 1	13	15
0 0 0 0	14	16

Table 1.

Never attempt to monitor a timing chip, such as a 74123, 8T22 or 555. The basic timing elements of the timer will not function normally with a TTL load attached to the external capacitor and resistor pins. All you really need to operate the unit is a little common sense and a good deal of practice. The more you use it, the more at home you *will be with it*, until, like me, you will be hard pressed to part with it as a diagnostic aid. ■

✓ *Reader Service—see page 195*

The Best of Both Worlds

Do you want to learn about microprocessors the right way? This article contains essential information on using and expanding the Heath ET-3400 microprocessor trainer.

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How would you like to buy a microcomputer that teaches you microprocessor theory and interfacing techniques, is a completely self-contained, portable unit and can be easily expanded to a full-scale developmental system? You can have the best of these features with the Heath ET-3400 microprocessor trainer and course.

Anyone involved in electronics today has no option concerning microprocessors; you must learn to work with them. Microprocessors are so intertwined with product development that a working knowledge of them will weigh heavily in determining your future progress in electronics. But where do you start?

The Initial Search

This was my dilemma as an engineering technician wanting to study microprocessors in depth. To learn system development, I had to start with a machine-language unit that would allow direct interaction with the microprocessor and give practice in constructing interface circuits to deal with the outside world. This eliminated from consideration prepackaged computers such as the Radio Shack TRS-80.

Primary in my considerations was a trainer backed by a good company offering excellent instructional materials and with a reputation for customer assistance if needed. Previous experience with Heathkits led to the obvious choice of their microprocessor trainer package. It has proved to be a wise investment. This article describes the trainer and course and provides full expansion details for construction of a microcomputer development system.

Photo 1. Complete Heath trainer and course.

The Whole Package

Photo 1 shows what you get for $269.95. The trainer kit assembles to a 6800-based microcomputer with a 1K ROM monitor, 256 bytes of RAM and ample breadboarding space. The microprocessor course comes in two large binders and includes two cassette tapes with accompanying flip chart for audiovisual reinforcement. Interfacing experiments are performed using the many auxiliary parts supplied with the course. An extra 256 bytes of RAM is included.

The Trainer

The well-designed trainer is shown in Photo 2 with some of the interface chips installed. What sets the Heath trainer apart Is its self-contained structure. You needn't carry along a separate power supply when transporting it; everything is in one neat package. Heath reserves 0.5 A of its 1.5 A, 5 volt supply for breadboard experiments and 50 mA of ± 12 volts. A standby power switch saves memory contents when the trainer is shut down. Six 7-segment LEDs display the status of any register or memory location upon command, and the registers can be changed at will while single-stepping through a program.

An impressive facet of the ET-3400 is its keyboard-controlled monitor program, which greatly simplifies program debugging. If a program fails to run at full speed, you can call up the program counter, initialize it to the proper beginning address and single-step through the program. Important registers can be examined and modified after each step. The entire program can be examined in memory by stepping forward and backward through the memory locations. The provision to insert up to four breakpoints to halt the processor at selected locations facilitates debugging in full-speed operation.

The trainer is heavily populated with buffered front panel connectors, which give access to every important microprocessor and memory control line. This is why expansion is so easily accomplished. Eight binary LEDs provide visual indication of input data, while a 1 Hz square wave provides a timing signal for line-controlled interrupt programming. Direct interfacing to external memory is accomplished via a 40-pin connector (not supplied), which can be installed at construction time. This connector is visible at the lower center area in Photo 2. My only criticism is the absence of an extra ROM socket, which would allow use of a BASIC programmed ROM.

Inner Details

The ROM monitor gives the user access to many interesting routines. In addition to the RESET routine used to initialize or halt the processor, OUTCH, REDIS, OUTHEX, OUTBYT and OUTSTI provide user control of displayed information. OUTput CHaracter used in conjunction with REset DISplay allows for sequential left-justified characters to be displayed one at a time. OUTput HEX decodes the hex value contained in the four least significant bits of accumulator A to determine the segment code for a character, which is then displayed by calling an output subroutine. OUTput BYTe allows two characters to be displayed by operating on the LSB and MSB of accumulator A.

Finally, OUTput STrIng permits the display of up to six characters simultaneously on the display, and in one demonstration program an interesting ticker-tape message is run across the displays to prove the versatility of this monitor. There are numerous other utility subroutines providing keyboard-scan control and program-debugging functions that are not user accessible.

The Course

Now let's look at the microprocessor course. One of the attractive benefits is the awarding of eight continuing-education credits upon successful completion of the course with a 70 percent or better grade on the final exam. No other company I know of offers this.

To call this a programmed course would not do it justice. Although the material is concise and flows well, it is also complete and gives an excellent introduction to microprocessors. Ten units are included, with eight being devoted to learning texts, while two contain the programming and interfacing experiments. Each unit is divided into subsections, and each subsection contains review quizzes at the end.

After completing all subsections of a particular unit, you are instructed to perform specific experiments using the trainer and auxiliary components. These experiments relate directly to the text material. This is followed by a unit examination that reveals whether you have absorbed the material and are ready for the next unit. Interspersed throughout the course are instructions to play a section of a cassette tape and use the flip chart to acquire new information not previously covered.

The course does assume some prior knowledge of digital theory, although the only area where this is really important is in the interfacing experiments. I do feel a non-hardware type could acquire a good machine-language programming background, but the real value of the course lies in its total system approach, teaching both microcomputer hardware and software theory.

Unit one deals with number systems and codes and the important binary, octal and hexadecimal codes and conversions necessary for computer operation. Unit two introduces microcomputer basics using a hypothetical microprocessor, which turns out to be a stripped 6800. This unit excels in tracing the path of digital information during a routine fetch-execute cycle and breaks down a microcomputer into its constituent sections. Addressing modes are examined also. Unit three examines computer arithmetic, showing addition, subtraction, multiplication and division by microprocessor. AND and OR operations are discussed.

Unit four is an extensive treatment of programming techniques where you begin to fully realize the microprocessor's power. Units five and six are concerned specifically with the 6800 processor and cover all the possible functions of this chip. Units seven and eight deal with the interfacing techniques necessary to connect the trainer to the real world. Unit nine contains the programming experiments, while unit ten deals with interfacing experiments.

Photo 2. Trainer close-up with breadboard circuitry.

The sketchy description above cannot adequately describe the scope of this course but gives some idea of what to expect. If you're looking for a good entry into the world of microcomputers and need to know them from the ground up, and want the experience of expanding the system using components of your choice, then consider this trainer. It is fully expandable and can be built into a reasonably versatile microcomputer system.

Expansion Considerations

Let's look at how just such an expansion is accomplished, including the necessary software to render the system operational.

When I completed the course, the initial fascination with blinking LEDs wore off, and I wanted more sophisticated functions. Input and output were possible using a previously obtained Radio Shack ASCII keyboard and a Zenith 12 inch black and white receiver.

My first major choice would have to be a video interface board. I chose The Digital Group TVC-32 video and cassette interface board for its dual functions and good performance specs. A full 128 ASCII characters are possible within a 32 × 16 display format, while the cassette interface portion allows up to 1200 baud memory loading.

Unfortunately, the financial situation at The Digital Group is now such that future availability of TDG equipment is in doubt. Selecting alternate video and cassette interface boards should be no problem given the following information.

The ASCII information received from a keyboard is processed by the peripheral interface adapter (PIA) shown in Fig. 1 under software control of the keyboard monitor program KEYMON. This gives a seven-bit ASCII output with a 250 ns strobe pulse, all of which appear at output pins 10-17 of the PIA.

When selecting your video interface board, look for one that accepts this ASCII-coded, strobed byte and performs the necessary character storage and generation on-board. This means the interface will need its own on-board memory to store the 512 ASCII characters (in the case of a 32 × 16 format) and feed them out to the CRT in the proper sequence. My experience has been limited to The Digital Group interface only, and I cannot recommend a specific alternate board at this time, but a scan of previous *Kilobaud* issues should help you locate a suitable board that can be used with little modification.

A serial bit stream is available for cassette memory storage at pin 10 of the PIA when the MEMDMP and MEMLOD programs are utilized. The requirements for an alternate cassette interface are minimal; the interface must have a standard serial input and the usual connections to a recorder. The MEMDMP and MEMLOD programs were written for operation at The Digital Group 1200 baud rate, and I would suggest purchasing a cassette interface that operates near this rate. Here again, scanning back issues of *Kilobaud* will help you select a suitable alternate.

To display the video information, I modified a Zenith 12 inch black and white receiver for direct video input using the hints in Don Lancaster's *TV Typewriter Cookbook*. An even better choice would be a professional monitor if money is no problem.

Reliable memory storage at a 1200 baud rate demands a good cassette recorder, and here my choice was the Craig 2628. Speed regulation is a strong 0.35 percent, and ac biasing assures good frequency response. A digital counter, important for locating previously recorded programs, is included.

Next, I needed a good power supply to support the interface board and additional memory to be added later. One of the best small-system supplies available is the Godbout design supplying 4 A of 5 volts with crowbar overvoltage protection, 500 mA of ± 12 volts and an adjustable fourth supply. This equips you to run the interface board and up to 16K of additional memory.

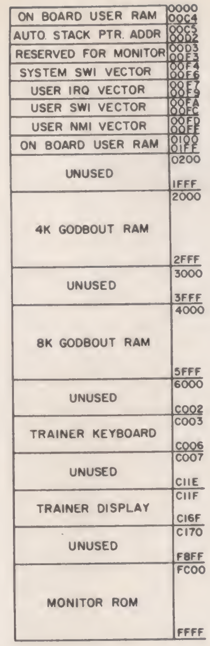

Fig. 2. Revised trainer memory map.

The last requirement for a good developmental system is memory. Problems arise with non-S-100 bus systems because special signals indigenous to this bus are not present with 6800-based computers, and extensive hardware is required to produce such signals.

One memory board readily adaptable to the Heath trainer is the Godbout Econoram VI providing 12K of memory split into 8K and 4K blocks. Originally designed for the Heath H8 computer, this board has standard signal requirements easily provided by the interface circuitry of Fig. 1.

Only two modifications need be made to the board. First, do not install the 5 volt regulators. The Godbout power supply is pre-regulated. Instead, run a jumper from each of the regulator's (U10, 11 and 12) input pads

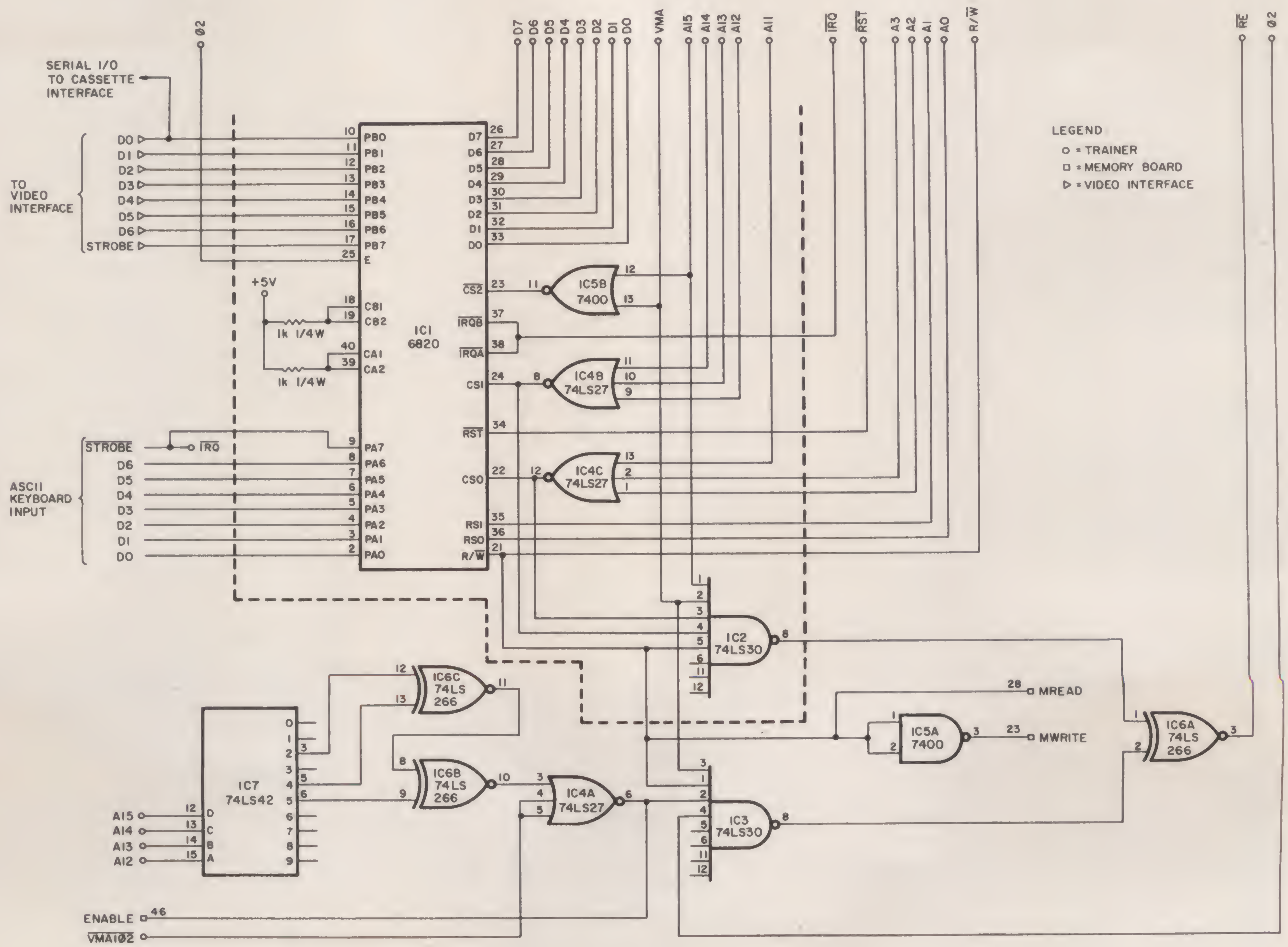

Fig. 1. System interface circuitry.

to their output pads. This connects the regulated 5 volts directly to the memory circuitry. Second, run a jumper from empty connector pad 46 to pin 4 of U5 and be sure switch number 8 is left in the down position. This is normally the board enable switch, but that function is controlled by the decoding circuitry of Fig. 1. Eliminate the edge connectors supplied with the kit and solder ribbon-cable connections directly to the board. The memory fits into the address slots shown on the memory map of Fig. 2, and Godbout's good documentation will aid you in setting up and using this board.

Photo 3 shows the completed system ready for programming. You may wish to build everything into an enclosure for a more professional appearance.

Interconnecting Tips

Once you've built your peripherals, interconnecting them will exercise the knowledge you've gained from the Heath course. The power supply connections are easily made to the board connectors with spade lugs used at the supply to facilitate individual board removal. Fig. 1 shows the necessary interconnections including coded pin numbers for the memory board.

Circuitry within the dotted lines is the Heath-recommended PIA setup, while the rest constitutes additional hardware (supplied) necessary to accomplish interfacing and decoding. I used the PIA because of its versatility in feeding information to and from the microprocessor. It's the only device needed for keyboard, cassette and memory.

The hard-wired connections from the video interface board to the breadboarded PIA are ribbon cable terminated in an AP Products connector, allowing for quick disconnect when trainer-only use is desired. Standard audio cables are used for data input/output from cassette to interface board,

Photo 3. System ready for programming.

while two toggle switches provide send-receive switching of the audio cables. The most tedious part of the project was hand-soldering the ribbon cable to the connectors, but the results are neat and convenient in disconnecting the system.

Finishing Up

Photo 4 shows the connections made to the trainer. Notice that all ribbon cable was cut as short as possible to avoid long-line noise problems. The connectors needed are two 929836-01 males and one 929975 female, available from AP products, Box 110Q, Painesville OH 44077. One male connector should be installed on the trainer during construction, and eight data lines should be run from the DATA I/O buffers to the 40-pin connector pads. Instructions for doing this are

KEYMON program.

```
                         NAM     KEYMON   MONITOR
                  *REV. 0.3
                         OPT     NOP
0000                     ORG     0
0001  CE  7E00           LDX     #$7E00   IRQ VECTOR
0004  FF  00F7           STX     $00F7    STORE IT
0007  86  4C             LDA A   #$4C     IRQ VECTOR
0009  97  F9             STA A   $F9      STORE IT
                  *SPELL ASCII ON LEDs
000B  BD  FE52           JSR     OUTSTR   IN ROM
000E  77                                  A
000F  5B                                  S
0010  4E                                  C
0011  30                                  I
0012  B0                                  I.
                  *PIA INITIALIZATION
0013  CE  0004    PIASET LDX     #$0004   MAKE SIDE A
0016  FF  8000           STX     $8000    AN INPUT
0019  CE  FF04           LDX     #$FF04   MAKE SIDE B
001C  FF  8002           STX     $8002    AN OUTPUT
001F  73  8002           COM     $8002    CLEAR IT
0022  86  DF      CURSOR LDA A   #$DF     UNDERLINE
0024  8D  1F             JSR     WRITE    DISPLAY IT
0026  8D  08             JSR     SPACE    SKIP SPACES
0028  86  A0             LDA A   #$A0     BLANK
002A  8D  19             JSR     WRITE    DISPLAY IT
002C  8D  02             JSR     SPACE    SKIP SPACES
002E  20  F2             BRA     $F2      DO IT AGAIN!
                  *SPACE SUBROUTINE
0030  0F          SPACE  SEI              MASK INPUT
0031  CE  01FF           LDX     #$01FF   DECIMAL 255
0034  7C  8002    INC1   INC     $8002    STROBE ON
0037  7A  8002           DEC     $8002    STROBE OFF
003A  09                 DEX              COUNT DOWN
003B  26  F7             BNE     INC1     CONTINUE
003D  0E                 CLI              ALLOW INPUT
                  *DELAY SUBROUTINE
003E  CE  3300           LDX     #$3300   DELAY TIME
0041  09          LOOP   DEX              COUNT DOWN
0042  26  FD             BNE     LOOP     CONTINUE
0044  39                 RTS              RETURN
                  *WRITE SUBROUTINE
0045  B7  8002    WRITE  STA A   $8002    DISPLAY IT
0048  7F  8002           CLR     $8002    STROBE OFF
004B  39                 RTS              RETURN
                  *INTERRUPT SERVICE ROUTINE
004C  C6  02             LDA B   #$02     ASCII CLEAR
004E  B6  8000           LDA A   $8000    GET DATA
0051  11                 CBA              IS IT CLEAR?
0052  27  3C             BEQ     CLEAR    SERVICE IT!
0054  C6  08             LDA B   #$08     ASCII BACK SPACE
0056  11                 CBA              IS IT BACK SPACE?
0057  27  21             BEQ     BSPACE   SERVICE IT!
0059  C6  0A             LDA B   #$0A     ASCII LINE FEED
005B  11                 CBA              IS IT LINE FEED?
005C  27  46             BEQ     NLINE    SERVICE IT!
005E  8A  80             ORA     #$80     SET STROBE
0060  8D  E3             BSR     WRITE    DISPLAY IT
0062  7C  00B1           INC     00B1     CHAR. COUNT
0065  7D  8000    TEST   TST     8000     KEY STILL DOWN?
0068  2A  FB             BPL     TEST     TEST AGAIN
006A  86  20             LDA A   #$20     DECIMAL 32
006C  91  B1             CBA     $B1      LINE FULL?
006E  27  05             BEQ     RESET    RESET COUNT
0070  8E  00D2           LDS     #$00D2   SET POINTER
0073  20  AD             BRA     CURSOR   RETURN
0075  7F  00B1    RESET  CLR     00B1     RESET COUNT
0078  20  F6             BRA     $F6      SET POINTER
                  *BACK SPACE SUBROUTINE
007A  0F          BSPACE SEI              MASK INPUT
007B  86  A0             LDA A   #A0      ASCII BLANK
007D  8D  C6             BSR     WRITE    DISPLAY IT
007F  CE  01FE           LDX     #$01FE   DECIMAL 254
0082  7C  8002    INC2   INC     $8002    STROBE ON
0085  7A  8002           DEC     $8002    STROBE OFF
0088  09                 DEX              COUNT DOWN
0089  26  F7             BNE     INC2     CONTINUE
008B  7A  00B1           DEC     00B1     CHAR. COUNT
008E  20  D5             BRA     TEST     CHECK KEY
                  *CLEAR SUBROUTINE
0090  0F          CLEAR  SEI              MASK INPUT
0091  86  FF             LDA A   #$FF     HOME COMMAND
0093  8D  B0             BSR     WRITE    SEND IT
0095  CE  0200           LDX     #$0200   DECIMAL 256
0098  86  A0      ERASE  LDA A   #A0      ASCII BLANK
009A  8D  A9             BSR     WRITE    DISPLAY IT
009C  09                 DEX              COUNT DOWN
009D  26  FB             BNE     $FB      CONTINUE
009F  7F  00B1           CLR     $00B1    RESET COUNT
00A2  20  C1             BRA     TEST     CHECK KEY
                  *NEW LINE SUBROUTINE
00A4  0F          NLINE  SEI              MASK INPUT
00A5  86  20             LDA A   #$20     DECIMAL 32
00A7  D6  B1             LDA B   $B1      GET COUNT
00A9  10                 SBA              WHAT'S COUNT?
00AA  97  B1             STA A   $B1      STORE COUNT
00AC  DE  B0             LDX     $B1      PUT IN INDEX
00AE  20  E8             BRA     ERASE    GO NEW LINE
00B0  00
00B1                     RMB              CHAR. COUNT
                         END
```

```
                             NAM     MEMDMP   MEMORY TO
                                              CASSETTE
                     *REV. 0.1
                             OPT     NOP
0100                         ORG     0
                     *PIA INITIALIZATION
0101  CE  FF04               LDX     #$FF04   MAKE SIDE B
0104  FF  8002               STX     $8002    AN OUTPUT
                     *GENERATE LEADER TONE
0107  86  01                 LDA A   #$01     SET UP
0109  B7  8002               STA A   $8002    MARK TONE
010C  CE  0005               LDX     #$0005   COUNT 1
010F  C6  7F         LOOP 1  LDA B   #$7F     COUNT 2
0111  86  7F         LOOP 2  LDA A   #$7F     COUNT 3
0113  4A             LOOP 3  DEC A            DOWN COUNT 3
0114  26  FD                 BNE     LOOP 3   CONTINUE
0116  5A                     DEC B            DOWN COUNT 2
0117  26  F8                 BNE     LOOP 2   CONTINUE
0119  09                     DEX              DOWN COUNT 1
011A  26  F3                 BNE     LOOP 1   CONTINUE
                     *RECORD DATA
011C  FE  014E               LDX     $014E    START ADDR
011F  C6  09                 LDA B   #$09     BIT COUNT
0121  0C                     CLC              CLEAR CARRY
0122  A6  00                 LDA A   $00      GET DATA
0124  B7  8002       START   STA A   $8002    STORE IT
0127  79  8002               ROL     $8002    START BIT
012A  86  40         STORE   LDA A   #$40     TIME IT
012C  4A             DELAY   DEC A            DELAY TIME
012D  26  FD                 BNE     DELAY    CONTINUE
012F  5A                     DEC B            LAST BIT?
0130  27  05                 BEQ     FINIS    IF SO, JUMP
0132  76  8002               ROR     $8002    NEXT BIT
0135  20  F3                 BRA     STORE    DO IT AGAIN
0137  86  01         FINIS   LDA A   #$01     SET UP
0139  B7  8002               STA A   $8002    STOP BIT
013C  C6  7F                 LDA B   #$7F     DELAY TIME
013E  5A             LOOP 4  DEC B            DOWN COUNT B
013F  26  FD                 BNE     LOOP 4   CONTINUE
0141  08                     INX              NEXT BYTE
0142  BC  0150               CPX     $0150    LAST BYTE?
0145  26  D8                 BNE              CONTINUE
                     *SPELL END ON LEDs
0147  BD  FE52               JSR     OUTSTR   IN ROM
014A  4F                                      E
014B  76                                      N
014C  BD                                      D.
014D  3E                     HLT              STOP
014E  xx                     RMB              START ADDR
014F  xx                     RMB              "" "" ""
0150  xx                     RMB              END ADDR
0151  xx                     RMB              "" "" ""
```

MEMDMP program.

```
                             NAM     MEMLOD   CASSETTE TO
                                              MEMORY
                     *REV 0.1
                             OPT     NOP
0159                         ORG     0
                     *PIA INITIALIZATION
0160  CE  0004               LDX     #$0004   MAKE SIDE B
0163  FF  8002               STX     $8002    AN INPUT
                     *LOAD DATA
0166  FE  019F               LDX     $019F    START ADDR
0169  86  08         START   LDA A   #$08     BIT COUNT
016B  B7  019E               STA A   $019E    STORE IT
016E  4F                     CLR A            GET READY
016F  C6  01                 LDA B   #01      TEST BIT
0171  F4  8002       WAIT    AND B   $8002    START BIT YET?
0174  26  FB                 BNE     WAIT     IF NOT, WAIT
0176  C6  60                 LDA B   #$60     MID BIT DELAY
0178  5A             LOOP 1  DEC B            COUNT DOWN
0179  26  FD                 BNE     LOOP 1   CONTINUE
017B  C6  01         MORBIT  LDA B   #$01     AND BIT
017D  F4  8002               AND B   $8002    1 OR 0?
0180  56                     ROR B            SEND TO CARRY
0181  46                     ROR A            STORE IN A
0182  C6  40                 LDA B   #$40     DELAY TIME
0184  5A             LOOP 2  DEC B            COUNT DOWN
0185  26  FD                 BNE     LOOP 2   CONTINUE
0187  7A  019E               DEC     $019E    LAST BIT?
018A  26  EF                 BNE     MORBIT   CONTINUE
018C  A7  00                 STA A   $00      STORE BYTE
018E  08                     INX              NEXT BYTE
018F  BC  01A1               CPX     $01A1    LAST BYTE?
0192  26  D5                 BNE     START    CONTINUE
                     *SPELL LOADED ON LEDs
0194  BD  FE52               JSR     OUTSTR   IN ROM
0197  0E                                      L
0198  7E                                      O
0199  77                                      A
019A  3D                                      D
019B  4F                                      E
019C  BD                                      D.
019D  3E                     HLT              STOP
019E  00                     RMB
019F  xx                     RMB              START ADDR
01A0  xx                     RMB              "" "" ""
01A1  xx                     RMB              END ADDR
01A2  xx                     RMB              "" "" ""
```

MEMLOD program.

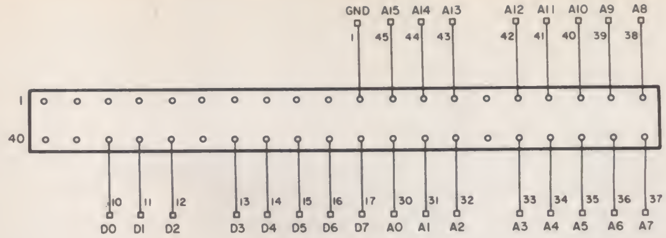

Fig. 3. 40-pin accessory connector pin-out.

in the Heath manual.

Fig. 3 shows the pin-out of the 40-pin connector and the proper connections to the Godbout memory board.

As an aid to programming the trainer with the added memory, I have included the revised memory map shown in Fig. 2. As you can see, there is ample memory for running 8K BASIC or extensive machine-language programs.

Software

Finally, you'll need some software to render your keyboard and cassette operational. The KEYMON program provides a software-controlled cursor, a clear-screen command, a back-space and an erase command and a new line capability. This was written for a 32-character-per-line interface; minor modifications will be needed for a 64-character video interface board.

The MEMDMP and MEMLOD programs, memory-to-cassette and cassette-to-memory, have timing loops that will generate a 5-second leader tone followed by the data. The trainer's LEDs will spell the word END when memory-to-cassette operation is completed, or spell the word LOADED when cassette-to-memory operation is done. Merely let the recorder run for five seconds after the appearance of either of these words, and a tone will appear to audibly signal the end of that cassette file.

One more hint: When entering the start and end addresses of the program to be recorded or loaded to memory, make the end address one greater than the actual end address. This will ensure that the last byte is recorded.

Final Thoughts

The Heath trainer provides an excellent way to enter the world of microprocessors. Whether you are an engineering technician or hobbyist, this package is an attractive, versatile and easily expandable system for learning the technology so necessary for advancement in the world of electronics. You truly can have the best of both the machine-language and advanced-function computer worlds with this system. ■

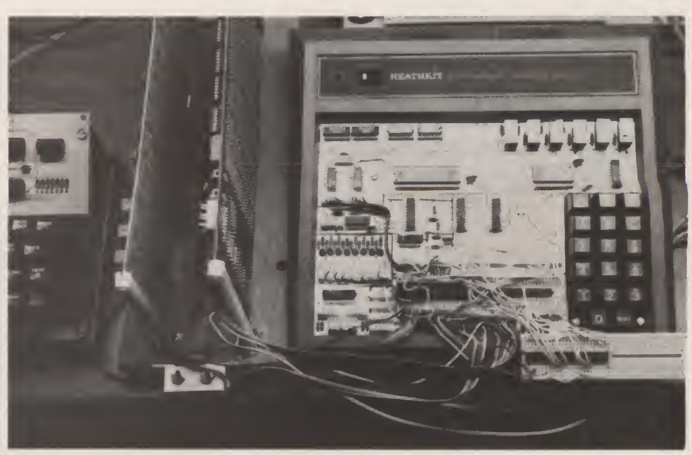

Photo 4. System interconnections.

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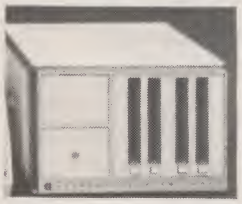

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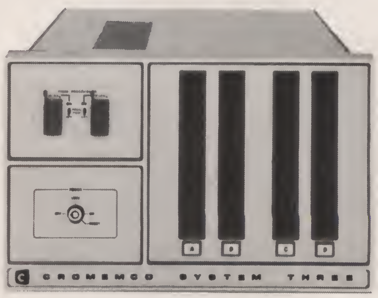

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Reader Service—see page 195

Another KIM-1 Expansion

Packaging the KIM-1, adding a TTL serial interface and adding 24K more memory for less than $300 using 2114s are the subjects covered by this KIM-1 expansion article.

John M. Blalock
3054 W. Evans Dr.
Phoenix AZ 85023

Can the MOS Technology KIM-1 be economically expanded to become a versatile high-level-language system? Is the KIM really just a "trainer board," to quote a Phoenix Byte Shop salesman? Why start with a KIM? This article will explain why I started with a KIM and attempt to answer these questions. It will explain the expansion steps I went through and describe in detail the most recent addition, a 24K static RAM memory board that cost less than $300. Even if you don't have a KIM (or a SYM) you might get a smile and perhaps some information from reading about my problems and my thoughts about 2114 static RAM ICs.

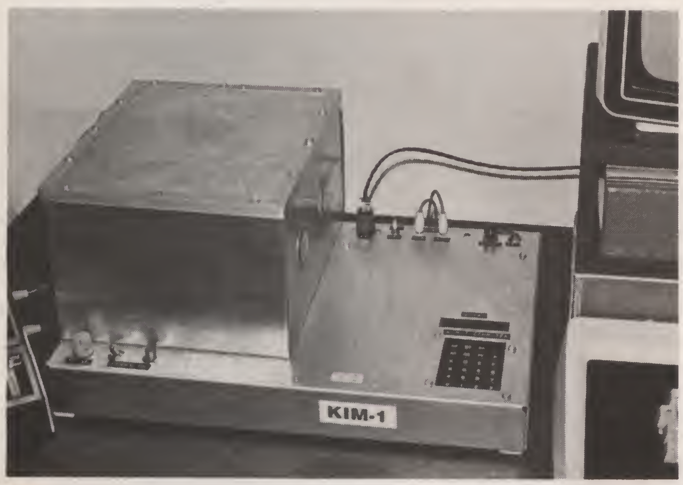


Photo 1. The author's KIM is in there?

Background

My interest in having my own computer dates from 1972, when I learned that my employer was paying just over $2000 for a PDP-8 with 4K of core. "One of these days I'll be able to afford one!" I thought.

Time went by, and I never got the money. Along came microprocessors and Altair, but I still couldn't come up with enough. Yes, I could stretch the budget and buy an Altair, Imsai, etc., but the price of the computer itself was just a start. To do much of anything with it would require adding memory, a terminal, cassette and serial interfaces. That SWTP kit and terminal looked attractive, but it was still over $1000 with the terminal, cassette interface and enough memory to run BASIC.

While I was still saving money, a friend got a MOS Technology KIM-1. I started to hear regularly about all the things it could do. A charter subscriber to both *Byte* and *Kilobaud*, I had already read several articles about the KIM. It had a built-in keypad, display, ROM monitor, TTY interface, cassette interface, etc. It could be expanded without too much difficulty. Only $245 plus a power supply and I could get started in personal computing! I could put off buying the terminal and more memory until later while still learning and having fun with the unexpanded KIM.

Getting Started

One Monday night, another amateur-radio operator listed a KIM-1 on our local two-meter swap net at a price I couldn't refuse. He needed cash badly and had mine the next day. That night I was practicing moon landings on my *own* computer. I played blackjack, Bandit, decoded Morse code, wrote several machine-language routines and more. Every month I looked forward to the next issue of *Kilobaud* to find out what new application or program someone had come up with for the KIM.

One of the first things I decided to do was to package the KIM along with its power supply. I put both in a 13 x 17 x 2 inch chassis. I purposely enclosed the power transformer area on top of the chassis in an 8½ x 11 x 6 inch box that was large enough to also house four or five S-100-size boards. See Photo 1 for a view of my KIM. The KIM board is bolted to the right underside of the chassis using 3/8-inch spacers. The keypad is readily accessible through the large cutout, and the display can be viewed through its cutout.

The next project was to add the S.D. Sales 4K memory board according to the article by Bob Haas in the April 1977 *Kilobaud*, "KIM-1 Memory Expansion," p. 74. That done, I bought a copy of Tom Pittman's Tiny BASIC, borrowed an ASR-33 Teletype and was really computing until I had to return the Teletype. Fortunately, I belonged to a company-sponsored computer club that was putting together a CRT terminal kit that was within the reach of my pocketbook—an ASR-33 wasn't. Work on the KIM slowed until I got the terminal working.

CRT Interface

The terminal's serial interface was designed to work directly with a modem like Ron Lange's in the November 1977 *Kilobaud* ("Build the $35 Modem," p. 94). Not wanting to use the parallel interface and lose the use of the KIM's monitor support of the 20 mA TTY interface, I decided to connect the TTY port to the terminal's TTL serial lines. See Fig. 1 for what worked for me: wire, two resistors and one IC; it couldn't be more simple.

So now I had a working system that not only used the onboard keypad and display to run all the programs in *Kilobaud* and the *First Book of KIM*, but I was also able to write short programs in Tiny BASIC. Soon it seemed that almost every program I wrote used up all available memory before it was completely written. Also, my teenager wanted to put more games on the system, most of which required either string-handling capability, subscripted variables or both. It was time to expand again.

Adding Even More Memory

I wrote Microsoft to ask about a full BASIC for the KIM. They referred me to Micro-Z, Box 2426, Rolling Hills CA 90274. Bob Kurtz at Micro-Z said that they had what I wanted. It required 9K bytes starting at hexadecimal 2000 just for the interpreter. 16K would be enough to handle the interpreter and short programs, but 20 or 24K would be much better.

The January 1978 issue of *Kilobaud* had a good article by John Eaton on interfacing the KIM to the S-100 bus ("Growing with KIM," p. 36). I could use his interface, get two Godbout 8K board kits and two S-100 connectors, and add 16K for just about $300. That seemed preferable to spending about $400 for 16K using 4K boards like those from Atwood. On the other hand, why not take advantage of the three-for-$375 price break from Godbout and add 24K for about $400? Of course, I could go with only two 8K boards, un-modify my S.D. Sales 4K board and have 20K

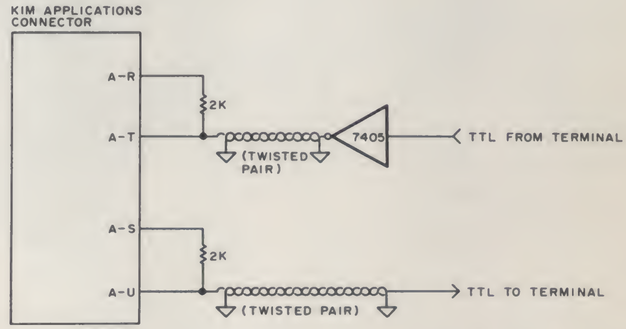
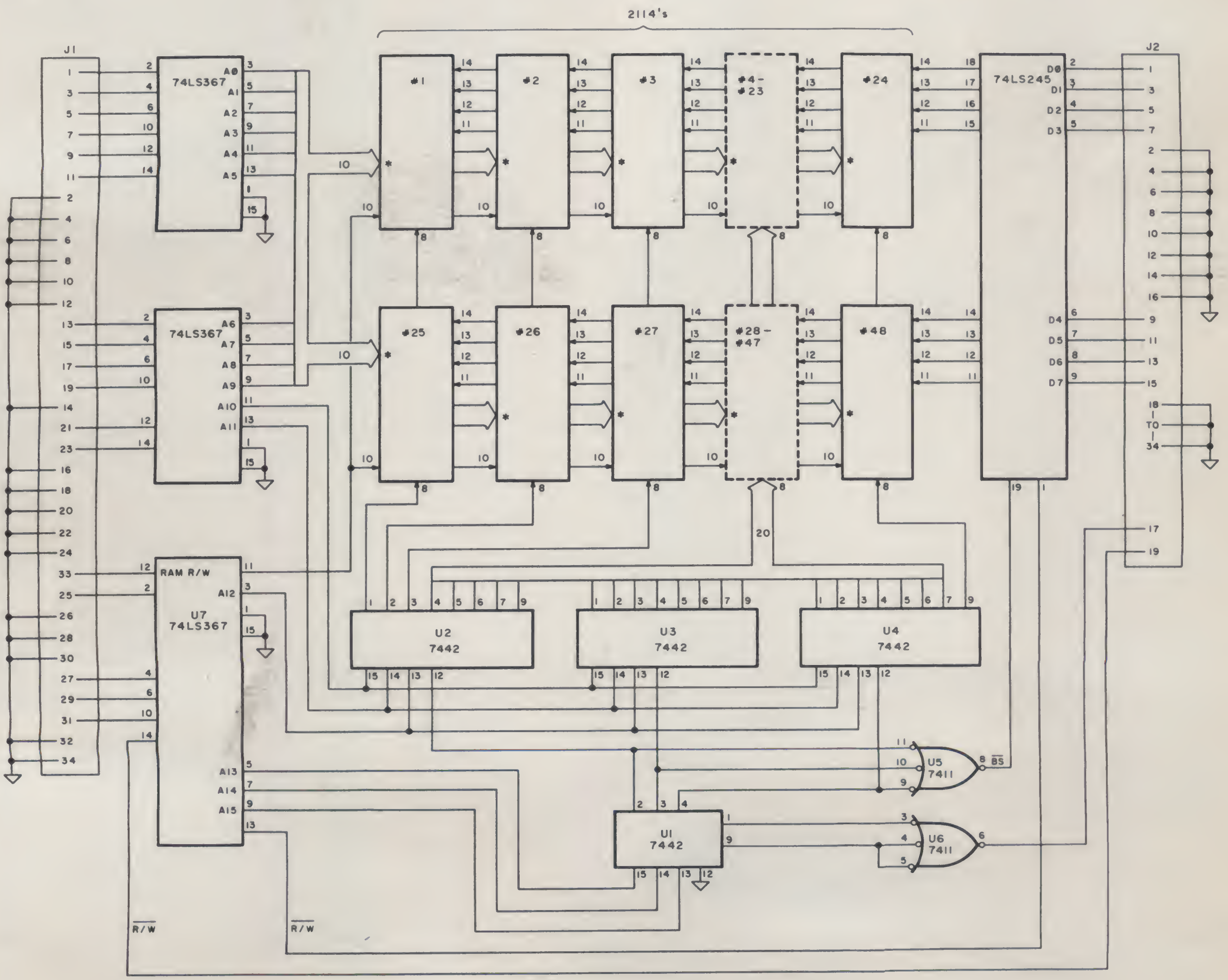


Fig. 1. Circuit to convert the KIM TTY port from 20 mA to TTL.



* 2114 ADDRESS LINES A0 THROUGH A9 ARE PINS 5, 6, 7, 4, 3, 2, 1, 17, 16 AND 15 RESPECTIVELY
Vcc - 7442 PIN 16, 74LS245 PIN 20, 7411 PIN 14, 74LS367 PIN 16, 2114 PIN 18
GND - 7442 PIN 8, 74LS245 PIN 10, 7411 PIN 7, 74LS367 PIN 8, 2114 PIN 9
SEE TABLE 1 FOR J1 AND J2 CONNECTIONS TO KIM

Fig. 2. Schematic of the 24K memory board design.

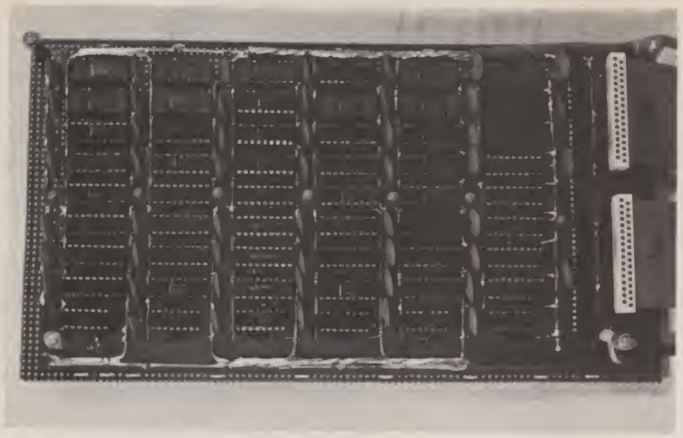


Photo 2. The 24K memory board.

for about $300 additional. This, however, would cost me the use and advantage of the programs I had from 0400 to 13FF.

Whichever way I went, I'd have to mount more S-100 connectors in the cabinet. Ever try to find a four- or five-slot S-100 motherboard? Wouldn't one of those Dynabyte 32K static RAM boards be nice? My income-tax refund wasn't *that* large, but then, with a board like that, I wouldn't need the motherboard. If 2114s didn't cost so much, I could probably fit 24K of them on one S-100 size board. . . .

I ruled out building my own dynamic memory board because of the refresh problem. There are no open slots for refresh in the timing of the 6502 used in the KIM. Apple uses dynamics, but they refresh them as part of their display updating.

I agree with others that the 2114 will be the next industry standard RAM, replacing the 2102 (see Digital Research Corporation's ads). The 2114 is fully static. It is organized as 1K by four bits. Only two 2114s are needed for 1K byte of memory. The main interfacing difference between the 2114 and the 2102 is that the 2114 has four bidirectional data lines. The 2102 has both a data-in and a data-out line. Since it can't be taking in data (a write operation) at the same time data is going out (a read operation), one line for each data bit is all you is need.

The 2114 is an 18-pin IC . . . compared to only 16 pins for the 2102. You get four times the memory capacity for just over one fourth the size. Prices for 2114s, even though they were going down, were still around $10 each in quantity. It looked as though I'd stick with 2102s.

While still trying to decide which way to go, I stopped to see Steve at Semiconductor Surplus (2822 N. 32 St., Phoenix AZ 85018) one Saturday. I spotted a sign: "2114s—$8.25 each." Steve assured me that the 2114s he had were not too slow. They were 200 ns versions! I told him that I liked his price but would have to wait until they came down to $5 each for 450 ns versions. Then they would be price-competitive with 2102s. Steve asked how many I needed. I said, "Forty eight, at least." He said, "I'll sell you 48 for $5 each." After verifying his guarantee, and the compatibility of the 2114-2 timing with that of the KIM, I went home with $252 worth of ICs (tax included).

Design of the 24K Board

Now to design a circuit for a 24K memory board to interface to the KIM. I decided to skip the S-100 interface compatibility goal as being an extra expense, but did decide to buffer every KIM line to the board. Fig. 2 is the result of my design effort.

The 74LS367s and 74LS245 would provide the buffering, the 7442s would provide address decoding and the 7411 would provide board select signals for the 24K board and for the KIM memory. I used 7442s instead of 74LS138s or other decoders due to their price, availability, available power and speed comparable to the other ICs. The 74LS245 is a bidirectional 8-line Tri-state transceiver. The level on pin 1 controls the data direction. Bringing pin 19 high causes the '245 to act essentially as an open circuit to the data lines from each direction. It is ideal for applications such as this. The 74LS367s provide negligible load to the KIM lines, so they are permanently gated on by grounding pins 1 and 15.

The '367s constantly provide address information (A_0-A_9) to the 2114s. This information is ignored until $\overline{CS}$, pin 8, of the 2114 goes low. 7442 U1 divides the 64K KIM memory space into eight 8K blocks. Either the $8K_0$ or $8K_7$ signal from U1 is used to enable the KIM memory onboard decoder. Enabling the KIM for just the lower 8K will work for its RAM and the S.D. Sales 4K addition, but the reset and interrupt vectors stored in KIM ROM are assumed to be in the upper 8K of memory. Therefore both $8K_0$ and $8K_7$ are used to enable the KIM.

7442s U2, U3 and U4 divide $8K_1$, $8K_2$ and $8K_3$, respectively, into 1K blocks. Since two 2114s comprise a 1K block, each of these 7442s provides the $\overline{CS}$ signal to sixteen of the 2114s. Only one pair of 2114s can be selected at any one time and respond to the address information from '367s.

Data will be written into or read from the selected 2114s depending on the state of 2114 pin 10, $\overline{WE}$. This level is controlled by the KIM RAM R/W signal, just like the KIM onboard 2102s.

The 74LS245 is enabled by the signal from U5. This signal is low if the KIM is addressing the 24K board (2000 to 7FFF hexadecimal). Data direction through the enabled '245 is controlled by the KIM $R/\overline{W}$ signal, which overlaps RAM R/W, thus eliminating propagation delay concerns.

Construction

According to my calculations, I would be able to fit this circuit on one of the S-100-compatible prototype cards. I planned to wire-wrap the connections. Making an etched board was out because the number of runs would require a double-sided board. This was more than I wanted to attempt. I couldn't find an S-100 prototype board that was compatible with the circuit; 74LS245s were unavailable then due to rumored poor manufacturing yield, and 18-pin wire-wrap sockets cost at least 50 cents each! There had to be a better way than spending $24 just for sockets. Remember, I was trying to stay within a limited budget.

I circumvented the lack of a 74LS245 by substituting two 8T28s and a 7402. I got forty eight 18-pin solder tail sockets for $12, and a large piece of .100 inch perfboard for $7. I borrowed a friend's wiring pencil and put it all together. See Fig. 3 for the schematic changes made to use the 8T28s and

J1	KIM	J1	KIM	J2	KIM	J2	KIM
1	E-A	18	GND	1	E-15	18	GND
2	GND	19	E-L	2	GND	19	E-W
3	E-B	20	GND	3	E-14	20	GND
4	GND	21	E-M	4	GND	21	SPARE
5	E-C	22	GND	5	E-13	22	GND
6	GND	23	E-N	6	GND	23	SPARE
7	E-D	24	GND	7	E-12	24	GND
8	GND	25	E-P	8	GND	25	SPARE
9	E-E	26	GND	9	E-11	26	GND
10	GND	27	E-R	10	GND	27	SPARE
11	E-F	28	GND	11	E-10	28	GND
12	GND	29	E-S	12	GND	29	SPARE
13	E-H	30	GND	13	E-9	30	GND
14	GND	31	E-T	14	GND	31	SPARE
15	E-J	32	GND	15	E-8	32	GND
16	GND	33	E-Z	16	GND	33	SPARE
17	E-K	34	GND	17	A-K	34	GND

Table 1. Connections to the KIM. A – 1 = Applications Connector, Pin 1; E – 1 = Expansion Connector, Pin 1.

Photo 2 for a picture of the finished 24K board.

The board measures 5½ by 10 inches. Ribbon cables from the KIM connectors plug onto two connectors mounted on the right side of the board. Next to them, oriented vertically, are the 74LS367s and 8T28s. The rest of the ICs are oriented horizontally in nine rows of six columns each. The top eight rows are the 2114s. The 7442s, 7411 and 7402 are located in the bottom row. Power and ground are routed next to each IC socket with #12 bare copper wire, liberally bypassed with fifty one .01 uF disc ceramic capacitors and seven 10 uF tantalum capacitors.

My junk box provided some #10 stranded wire, which was soldered to the power and ground buses and connected to the 5 V regulated supply. The ribbon cables were made from a 36-inch 34-wire jumper cut in half. Every other wire was connected to ground at the 24K board and at the KIM to minimize the possibility of cross-talk or pickup.

The power and ground buses are held in place by #22 wire loops to the board and by #22 wire connections soldered to the adjacent voltage or ground pin at each socket. The sockets are attached by these same connections plus a drop of epoxy on each side of every socket. There are four holes in the .100 inch perfboard between each column of 18-pin sockets . . . and one hole between rows.

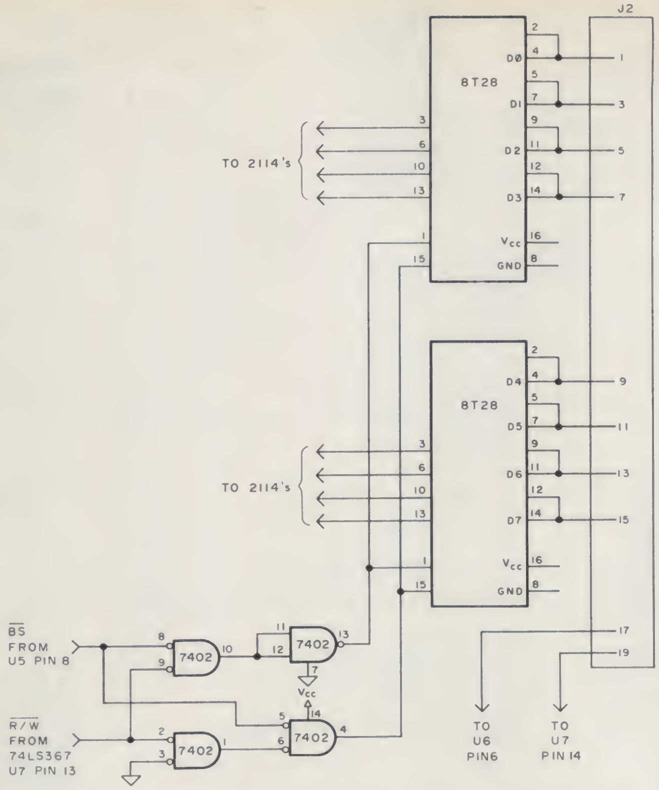


Fig. 3. Modifications to use 8T28s in place of the 74LS245.

Wiring approximately 900 joints and soldering them was tedious, but not as bad as I expected. The wiring pencil worked as advertised, but the wire was a little hard to solder. At least a 37 Watt iron is needed to melt through the insulation and get a good joint. I buzzed out every connection and only found one such bad joint!

Checkout

After I found a wiring error and a few bad 2114s, the added memory worked just as I expected it would. The board draws under 3.5 A from my 5 V supply. Total cost was almost $290, still within budget.

Steve's guarantee on the 2114s was tested and proven good. The Micro-Z version of Microsoft's 6502 BASIC is even better than originally advertised. They've added a Hypertape SAVE routine to speed up the cassette interface and included a data-save/data-load feature. The KIM has 15183 bytes free for BASIC programs, which should be enough to hold almost all programs I care to type in. Speed is almost twice as fast as a Radio Shack TRS-80 with Level II BASIC.

Conclusions

I've spent almost as much for my system as the price of a TRS-80 with 16K RAM and Level II BASIC, but it has some features the TRS-80 doesn't. It's been fun and educational getting here. Yes, the KIM can be expanded into a versatile high-level-language system. No, it's not just a "trainer board." Now for a printer and floppy disk.

When I wrote this article, 450 ns 2114s were being advertised in *Kilobaud* as low as $5.50 each in quantities of 100 and up. 450 ns is fast enough for KIM. By the time you read this, I expect that 2114s will be generally available for $5 or less, so you too can break that $100-per-8K price barrier and add more memory to your KIM. ■

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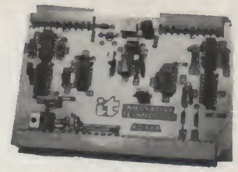

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Adult Caloric Requirements in Xitan BASIC

Summer's still here, and it's pig-out time . . . picnics, beer, ice cream. If you're not careful, it could be heart-attack time. This program will help you constructively count calories.

Dr. John R. Cameron
PO Box 1517
Palo Alto CA 94301

An evolution is occurring in the practice of medicine in which microcomputers will be increasingly utilized, both within the medical profession and in our daily lives. In the hospital, more and more sophisticated (and potentially less expensive) patient-monitoring and analytic tools have become available due to advances in solid-state "intelligence." Moreover, increased awareness of personal health care is allowing people to take more responsibility for their own well-being. Microcomputers can play a part in this endeavor as well.

```
Program for the Determination of Adult Energy Requirements

Responses should be a capital letter or number followed
     by a carriage return (CR).
Are you a Female (F) or a Male (M) - CR? F
What is your age in years - CR? 28
Measurements may be in kg/cm (Metric) or lb/in (English).
Do you use Metric (M) or English (E) - CR? E
What is your Weight (in light clothing) - CR? 145
What is your Height (cm or in, w/o shoes) - CR? 66.5
What is your present Ideal Weight - CR? 140
How many hours per average day are spent doing the following:
Sleeping - CR? 8
Lying Down Awake - CR? 1
Sitting or Standing (e.g. reading or waiting) - CR? 12
Light Activity (e.g. cooking or walking) - CR? 2
Moderate Activity (e.g. active work) - CR? 1
Heavy Activity (e.g. running or climbing) - CR? 0
Average diets have about 15 percent of their Calories as Protein.
What percentage of your Caloric intake is Protein - CR? 25
Are you Pregnant (Y or N) - CR? Y
How many weeks Postconception are you - CR? 15

Your calculated Basal Metabolic Rate is 1759 Calories.
Your calculated average daily Caloric requirement is 2516 .
Your stated Ideal Weight minus actual Weight is:
        63.56 - 65.83 = -2.27 kg or -5 lb
Typical Ideal Weight for your Height is 64.62 kg or 142.3 lb +/-10%.
This includes a 2.27 kg or 5 lb addition for pregnancy of 15 wks.
Do you wish a diet schedule (Y or N) - CR? Y
An often recommended goal for weight change is 0.5 kg(1 lb)/wk.
How many weeks do you wish to make the diet for? 5
Daily intake should be 2516 + -543.3 = 1973 Calories for -.454 kg/wk.
This assumes that your Caloric intake is still 25 % protein.
Pregnancy will alter these results.
```

Sample run.

The real front line of medical care is in the home. A personal microcomputer can help you manage your life to reduce the various stresses that contribute, sometimes insidiously, to the development of many diseases. Activities in our daily lives that can be measured by a computer are presently few in number but are sufficient for a start, and their number is expanding.

What Is Being Done

One example of this microcomputer application is the use of a BASIC program to correlate insulin dosage with urine glucose output in a young diabetic as described by M. Tekulsky (December 1978 *Interface Age*, p. 70). Of wider applicability is the correlation of pulse rate and exercise activity described by A. Gerbens in "A Strategy for Healthy Living" (June 1978 *Kilobaud*, p. 32). The latter article discussed the possibility of direct pulse monitoring—a useful expansion in the number of parameters available to microcomputer analysis.

Your eating habits are some of the more important contributors to your health or disease. This is an area of great contention, but it is a simple fact that your weight is primarily determined by a usually predictable interaction between how many calories you eat and how physically active you are. Due to an excess of the former (especially as fats) and a distinct dearth of the latter, the average middle-aged American gains a pound a year. With varying degrees of certainty, excessive weight gain has been correlated with several common diseases, including late-onset diabetes, high blood pressure and heart failure.

Some people find "counting calories" to be an essential tool in regulating their weight. The rising costs of food add to the value of efficient meal planning.

This article presents a BASIC program that allows the determination of daily caloric requirements and a diet schedule using several factors, including physical-activity level. For someone with a microcomputer, this program can be an inexpensive step toward weight control, the pursuit of which presently supports a billion-dollar industry. I hope it is a step in the direction of making home health care a little easier.

The Program

The program is written in Xitan SuperBASIC. It uses 28 variables (with two-letter designations) and requires less than 4K of memory. The program structure is generally linear and self-explanatory. There are a few lines with multiple statements separated by colons, where it is assumed that your BASIC skips to the next line if an initial conditional statement is not true.

Exotic commands have been avoided. As in many BASICs, "?" is used as the abbreviation for PRINT, and LINE INPUT waits for a string answer as INPUT waits for a numeric parameter; both of these commands utilize prompt strings. ASC(SX$) returns the ASCII numeric value of the first character in the SX$ string (SX$ and SX are independent). An apostrophe demarcates remarks at the ends of lines.

Equations in the program use your sex, age, height and weight (internal calculations are metric) to determine your basal metabolic rate (BMR—lines 390 and 430). The BMR is the number of calories your supine, awake body would use in a day at a normal room temperature. It is the basis for all calculations of caloric requirements. Certain diseases including diabetes, malnutrition, thyroid hormone imbalances and major infections can influence it, but the great majority of persons tested have the predicted BMRs. Exposure to high- or low-ambient temperatures for a large part of the day will increase the BMR. Fever increases the BMR 13 percent for each degree centigrade.

The equations used were originally prepared by Harris and Benedict in 1919 (as presented by E. F. DuBois, *Basal Metabolism in Health and Disease*, 1936). They are based on thousands of direct BMR measurements and bypass the commonly used inexact dependence of BMR on body surface area. DuBois commented on the difficult process of doing these calculations in a time before any electronic calculators. (I wonder what he would think about personal microcomputers!)

The calculation of actual caloric requirements (line 480) uses an activity factor derived (lines 400 and 440) from the relative proportion of time spent in various activities—most of us sit, stand or lie down most of the day. Also included is the amount of energy required to digest food, especially protein. Thus, the question about your protein intake is included. It is not a critical parameter.

Calculation of typical ideal weight for your height uses equations (lines 410 and 450) I derived from tables prepared by the Metropolitan Life Insurance Company to determine life expectancy—another example of the importance of maintaining a desirable weight. Most people know what their ideal weight is, however, and this stated ideal weight is used in the diet calculations. In many people, their ideal weight is attained about the age of 25. Other dietary information was obtained from "Recommended Dietary Allowances" by the National Academy of Sciences, 1974.

All of these calculations have some amount of uncertainty, which rises at the extremes of input parameters. Before the age of puberty and for several years thereafter, people have widely varying and proportionately higher BMRs. Therefore, this program excludes persons under the age of 19. Also, people who are underweight or overweight have different caloric requirements since the BMR is best correlated with lean body weight. Conditional statements in the program were designed to catch most improper or extreme responses.

Application

Using the program is easy. Instructions lead the user along as information is requested. A sample run is given for a pregnant woman.

Consideration has been given to the increased caloric requirements and weight gain of pregnancy; however, other factors must also be taken into account. The diet schedule in the sample run shows a caloric intake that is said to result in a loss of one pound a week for five weeks. This is true with respect to the woman's ideal weight for each week during pregnancy, but this ideal weight increases one pound for each week past ten week's postconception.

```
10 ?:?"Program for the Determination of Adult Energy Requirements":?
20 ?"Responses should be a capital letter or number followed"
30 ?"     by a carriage return (CR)."
40 LINE INPUT "Are you a Female (F) or a Male (M) - CR";SX$
50 SX=ASC(SX$):IF SX<>70 AND SX<>77 GOTO 40
60 INPUT "What is your age in years - CR";AG
70 IF AG<19 THEN ?"Sorry, not accurate for age less than 19.":END
80 ?"Measurements may be in kg/cm (Metric) or lb/in (English)."
90 LINE INPUT "Do you use Metric (M) or English (E) - CR";MS$
100 MS=ASC(MS$):IF MS<>69 AND MS<>77 GOTO 90
110 INPUT "What is your Weight (in light clothing) - CR";WT
120 INPUT "What is your Height (cm or in, w/o shoes) - CR";HT
130 INPUT "What is your present Ideal Weight - CR";IW
140 IF MS=69 THEN WT=WT*0.454:HT=HT*2.54:IW=IW*0.454 'English to Metric
150 IF WT<40 OR WT>100 THEN ?"Sorry, not accurate for your Weight.":END
160 IF HT<140 OR HT>200 THEN ?"Sorry, not accurate for your Height.":END
170 ?"How many hours per average day are spent doing the following:"
180 INPUT "Sleeping - CR";A1:INPUT "Lying Down Awake - CR";A2
190 INPUT "Sitting or Standing (e.g. reading or waiting) - CR";A3
200 INPUT "Light Activity (e.g. cooking or walking) - CR";A4
210 INPUT "Moderate Activity (e.g. active work) - CR";A5
220 INPUT "Heavy Activity (e.g. running or climbing) - CR";A6
230 TA=A1+A2+A3+A4+A5+A6 'Total Daily Activity Hours
240 IF TA<22 OR TA>26 THEN ?"Does not add up to one day.":GOTO 170
250 ?"Average diets have about 15 percent of their Calories as Protein."
260 INPUT "What percentage of your Caloric intake is Protein - CR";DP
270 IF DP<0 OR DP>100 GOTO 260
280 PF=1.06+(DP-15)/100*0.28 'Protein Digestion Factor Calculation
290 FC=0:PC=0:PW=0 'Zero Female Correction Factors
300 IF SX=77 GOTO 430 'Female Calculations Follow
310 INPUT "Are you Pregnant (Y or N) - CR";PR$
320 IF ASC(PR$)<>89 GOTO 360
330 INPUT "How many weeks Postconception are you - CR";PC
340 IF PC>10 THEN PW=0.454*(PC-10):FC=300 'Pregnancy Correction
350 GOTO 390
360 INPUT "Are you Lactating (Y or N) - CR";LC$
370 IF ASC(LC$)=89 THEN FC=500:GOTO 390 'Lactation Correction
380 IF ASC(PR$)<>78 OR ASC(LC$)<>78 GOTO 310
390 BM=655+9.6*WT+1.8*HT-4.7*AG 'Basal Metabolic Rate Calculation
400 AF=(0.9*A1+A2+1.3*A3+2.6*A4+4.1*A5+8.0*A6)/TA 'AF=Activity Factor
410 CW=0.00192*HT^2+0.0448*HT+PW 'Calculation of Optimal Weight, CW(HT)
420 GOTO 460 'Skip Following Male Calculations to Printout Section
430 BM=67+13.8*WT+5.0*HT-6.8*AG
440 AF=(0.9*A1+A2+1.5*A3+2.9*A4+4.3*A5+8.4*A6)/TA
450 CW=0.00177*HT^2+0.088*HT
460 PRECISION 4 'Printout But Not Calculation Is Limited to 4 Places
470 ?:?"Your calculated Basal Metabolic Rate is";BM+FC;"Calories."
480 KC=(AF*BM+FC)*PF
490 ?"Your calculated average daily Caloric requirement is";KC;"."
500 ?"Your stated Ideal Weight minus actual Weight is:"
510 ?TAB(10);IW;"-";WT;"= ";IW-WT;"kg or ";(IW-WT)/0.454;"lb"
520 ?"Typical Ideal Weight for your Height is";
    CW;"kg or";CW/0.454;"lb +/-10%."
530 IF PC>10 THEN ?"This includes a";PW;"kg or";PW/0.454;
    "lb addition for pregnancy of";PC;"wks."
540 IF IW-WT=0 THEN END
550 LINE INPUT "Do you wish a diet schedule (Y or N) - CR";DI$
560 IF ASC(DI$)=78 THEN END
570 IF ASC(DI$)<>89 GOTO 550
580 ?"An often recommended goal for weight change is 0.5 kg(1 lb)/wk.
590 INPUT "How many weeks do you wish to make the diet for";DT
600 IF DT=0 THEN END
610 ?"Daily intake should be"KC;"+ ";(IW-WT)*1100*PF/DT;"=";
    KC+(IW-WT)*1100*PF/DT;"Calories for ";(IW-WT)/DT;"kg/wk."
620 ?"This assumes that your Caloric intake is still";DP;"% protein."
630 IF PC>0 THEN ?"Pregnancy will alter these results."
640 END
```

Program listing.

So in this example, her actual weight would remain approximately constant for five weeks on a 2000 calorie diet and then rise again at one pound per week when she resumed her normal diet of about 2500 calories. It should be emphasized that during pregnancy attention is best placed on proper nutrition in consultation with your physician, rather than on weight loss.

In using this program, bear in mind that it is derived by taking averages from many American adults. It is possible that your weight and caloric requirements may differ somewhat from those given, especially during pregnancy.

If you do decide to take control of your eating habits, I suggest that you exercise moderation in designing your plan. A balanced, widely varied selection of foods is likely to be more beneficial and do less damage during a lifelong diet. Fasting has intriguing psychological aspects but hardly suffices for long-term weight control. Increased activity with the same caloric intake may offer an alternative for you. ■

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Modification Steps

1. Disassemble the keyboard unit by removing the six mounting screws and separating the two PC boards.

2. Locate Z56 (74LS92). On the foil side of the board, cut the foil leading from pin 8 to the only plated-through hole.

3. Mount an SPDT switch onto the board, close to Z56, but in a position that will not short any other foils together.

4. Solder a wire to the center connection of the switch and the other end to the plated-through hole noted in step 2.

5. Run another wire from one side of the switch to pin 8 of Z56. (In this position, the computer will operate at normal speed.)

6. From the other side of the switch, connect a wire to pin 14 of Z56 (this is an unused divide-by-2 gate).

7. Now run a wire from pin 2 of Z43 to pin 14 of Z56 (this supplies a clock/2 to our divider).

This completes the conversion, other than cutting a small hole in the cabinet so you will have access to the switch. Note: Because of the increase in speed and data transfer, your old programs will not load in at the higher rate. (That's why the switch is there.)

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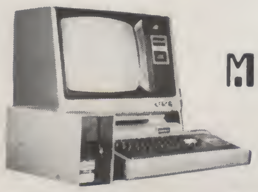

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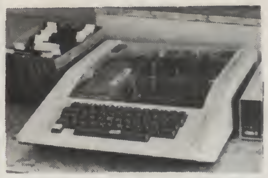

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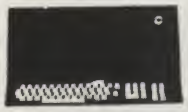

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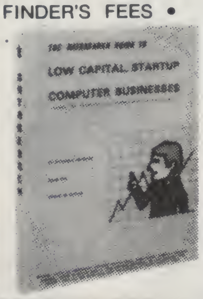

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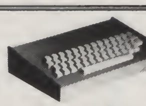

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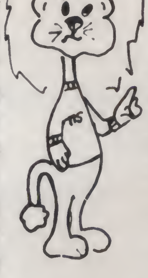

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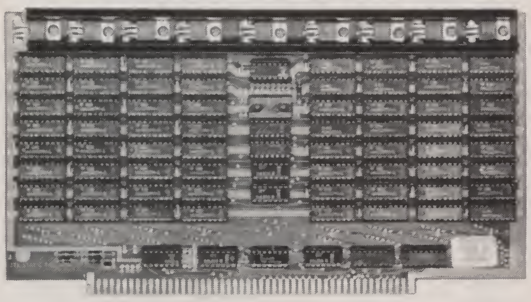

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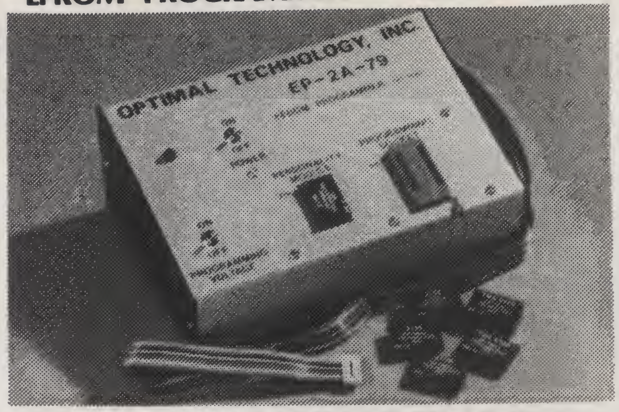

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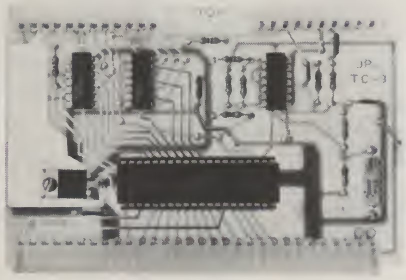

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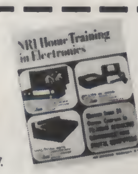

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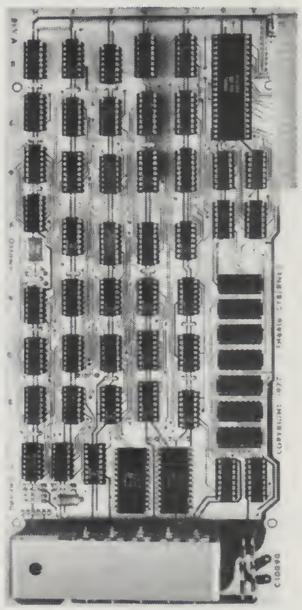

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Must Sell . . . Need Money A fully populated OSI Challenger III System. Includes 32K, dual 8" floppies, keyboard, video, cassette, graphics, monitor, 16 serial I/O board, 2 8-bit D/As, 1 A/D with 8 channel multiplexer, 3 parallel I/Os, 1 megabyte memory management, software switchable address for all three micros, with connecting cables . . . fully operational. Will sell for $4500. Plus 5 free disks of software with purchase, includes BASIC, Assembler, Editor, CH III Op Sys, WP-1A, OSI Level 1 and much, much more. Pat Reynolds (713) 674-8367.

Ohio Scientific C2-4P with connected RS-232 port and switch selectable baud rates, works perfectly. Cost $598: will sell for $498. Pat Reynolds (713) 674-8367.

For Sale: SWTPC 6800 computer with 12K memory, SWTBUG, serial and parallel I/O; CT-1024 terminal with scrolling mod in Enclosure Dynamics case; AC-30 cassette interface; GT6144 graphics board with joystick. Each housed in separate cases; all interconnecting cables, full documentation and large variety of software (SWTPC 4K and 8K BASIC, Microsoft BASIC, assembler, games). $650. R. Maryanski, 424 Grant Ave., Eatontown NJ 07724 (201) 542-4735.

Digital Group System Z-80 CPU, 26K memory, 16×64 CRT, 2 Phi-Decks, Expandor Printer, cassette recorder, extensive software, all documentation and loads of extras: $3,500. Paul A. Teseny, 17 DeKalb Place, Morristown, NJ 07960. (201) 539-6876, Evenings.

For Sale: 32K static RAM board, S-100, 450 ns, 32K boundaries, asmbld & tested; $550 postpaid. Imsai cassette interface board, S-100, asmbld; $40 postpaid. Wm. Peterson, Caltech 158-79, Pasadena CA 91125.

Upgrading to larger system. TRS-80 CPU w/16K RAM, CRT, tape recorder: all for $750. TRS-80 expansion interface w/32K RAM; $450. Two disk drives (Radio Shack's); $450 each w/cable. Four non-Radio Shack disk drives (designed for TRS-80 use, however); $400 each. Centronics 779 printer w/tractor feed; $1200. Bruce Taylor, 118 So. Mill St., Pryor OK 74361. Call (918) 825-4844.

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4 printers with keyboards ($395 ea). Reconditioned, Singer, dot-matrix impact, 80 char, ASCII, 110/300 baud, async, RS-232 interface, friction or pin feed. M. Osedo, 1367 Nanawale Place, Kailua HI 96734.

TI-751 Baudot RO printer for sale. New printhead, manuals, not working—$150. RCA COSMAC-based video game as sold by Radio Shack—$50. Ralph Droms, Whitmore Lab, Univ. Park PA 16802.

For sale: Microterm Act V CRT, 24×80 upper/lower, numeric key pad, $825; TI 810 printer, upper/lower, form feeds, $1750. Both hardly used. L. Williams, Box 554, Elmhurst IL (312) 530-7266.

For Sale: Minicomputer & Software. 64K CPU, 10M byte disk, 5 fix, 5 removable, 165 cps printer, 2 CRTs, 10 disk packs, up to 8 CRTs, 300 lpm printer, more disk & core too. Software—over 100 programs for warehouse distribution, order entry, invoicing, A/R, inventory control, sales analysis, history & commissions, systems diagnostics, many games. $30K. David Mayer, PO Box 1494, Englewood Clfs NJ 07632.

TI silent 700 model 743 sends and receives serial ASCII code, 10 or 30 cps. 2 rolls paper, cable and manual like new. Will ship COD for $700. J. Church, 3570 Cortez, Dallas TX 75220. (214) 352-9568.

SWTPC CT-64, $275 and AC-30, $65. Both for $340. Professionally assembled, working, in as-new condition, and with documentation. R. P. Felton, P. E., 4803, Neblina Dr., Carlsbad CA 92008. (714) 729-5519.

Digital Group Z-80 26K system with Centronics 700 printer, four Phi-deck digital cassette drives, all cabinets, PHIMON monitors, Business Basic. Used 12 months. Best offer over $4500 plus shipping. Bob Brecount, 3301 Morningside, Victoria TX 77901. (512) 575-1257.

For Sale: Assembled Heathkit H8, H9 and cassette recorder. 24K memory, serial interface, most software (including Heath extended BASIC), manuals, most HUG mags to date. Kit cost near $1800, will sell for $1440. G. Counsil, 1258 33 Ave., San Francisco CA 94122. (415) 664-4508.

H8 Users! Tired of lack of support for your H8? I have available a set of construction articles of various useful things to do with your H8 via a parallel board: 16 Channel controller, Selectric interface, jogging computer, DAC, Telephone controllers, etc. For more info, write Henry Fale, 2918 S. 7th. St., Sheboygan WI 53081. (414) 452-4172.

Line printer, Tally T-2200, 200 lpm, 132 columns, 5×7 matrix, up to 6 copies, adjustable tractors, 6/8 lpi, 8ch. VFU, parallel interface: cost $5000, asking $1600. Also available: warranty, service contract, other interfaces. John Marshall, Box 242, Renton WA 98055. (206) 226-0981.

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3 Heath H-11 (or DEC PDP 11/03) static memory boards, 4K×16, practically new. $200 each or $575 for all 3. M. Lowenstein, 79 Larkspur Road, Stamford CT 06903. (203) 853-7856.

New/Never Used Cromemco System Three 32K. Complete with 3355 Daisy-wheel printer and 3101 CRT terminal. Cost $11,980, will sell for $8,900. 159 Catherine Lane, Grass Valley CA 95945. (916) 273-4451.

Heathkit H9 terminal modified for 24 lines, upper/lower case entry and display, clear screen $250. Herb Swearengen, 45 Apple Way, Frederick MD 21701 (301) 662-8225 or 882-9583.

For Sale: S&D Sales 4K RAM, $50. Shugart SA-400 w/pwr. supply & cab., $290. Micromation Per-Sci Double Density, $2200. Mits serial I/O board, $100. Vector Graphic PROM/RAM, $75. 10 1702A PROMs, $35. S&D Cassette Interface, $14. 3P+S I/O board, $130. Flexowriter w/S-100 interface, punch & reader, $375. Fred Manthey, Mullan ID (208) 744-1143.

For Sale: Three 16K static RAM boards. Wameco boards; assembled and working perfectly, (with 2114s Lpower 250 ns). Address 4Kbyte, bank select, much more. $275 ea; all for $789. Also have 2114s for $5 ea; 4116s for $7.75 ea; 4027 $3 ea; 2141s $4.50 ea; 2708s $8 ea; 2716s (+5V) $39 ea; and FD1771B01s $32.25 ea. Richard Smith 3648 Madrid Dr., San Jose CA 95132. (408) 946-0735.

Heathkit H8-4 4 port serial board with all 4 adapter cables. Assembled and working, $125. Herb Swearengen, 45 Apple Way, Frederick MD 21701. (301) 662-8225 or 882-9583.

Heathkit 12K memory board by Godbout. Up and working $100. Herb Swearengen, 45 Apple Way, Frederick MD 21701. (301) 662-8225 or 882-9583.

Heath WH-17 single-drive floppy disk and controller card. With manuals and software $500. Herb Swearengen, 45 Apple Way, Frederick MD 21701. (301) 662-8225 or 882-9583.

Heathkit H8 computer with serial and parallel I/O, 32K RAM, software. Up and running $900. Herb Swearengen, 45 Apple Way, Frederick MD 21701 (301) 662-8225 or 882-9583.

For Sale for Lease: Intell MDS 220 with double density disk drive and ICE 80. Also PROM programmer and line printer. Contact Gizelle Gil, 3156 Avalon Ct., Palo Alto CA 94306.

Wanted: Grain farming operation looking for record keeping and analysis software that can be used in business. Presently own TRS-80 16K Level II but will be going to 32K DOS. Please write to: Kenneth Gottfried, R1, 168 Mt. Zion Rd., Nevada OH 44849.

Wanted: Will pay reasonable price for wired and working E&L's MMD-1 micro system. Gerald Malseed, 8102 La Salle Rd., Towson MD 21204. 825-4266, leave phone no., will call back.

Xitan (TDL) SMB-2 board w/doc. New, but won't work w/Vector CPU. $325 or best offer. Computer store refuses to give refund. C. Heidl, 6617 Vesta Brook Dr., Morrow GA 30260.

Heath H9 video terminal, $375. SWTPC CT-64 with Motorola 12 MHz monitor, $300. L. Williams, Box 554, Elmhurst IL 60126. (312) 530-7266 after 5 PM.

Imsai 8080 22 slot 16K RAM 2K EPROM, Bytemover, Tarbell cassette, 3 P+S IO, full documentation: up and running; incl. 8K BASIC. Any offer over $1200. H. M. Posner, 1905 W. Flora, Santa Ana CA 92704.

For Sale: Won as computer club door prize, C-10 leaderless computer cassettes 75¢ ea; 25 for $16.25; 50 for $27.50; 100 for $50. Also blank cassettes, C-45/75¢; C-60/$1; C-90/$1.35 ea. Write/call for quantity prices. These cassettes are top quality BASF high output, low noise tapes, 5-screw shell with protective plactic case. A. Ringel W6KVO, 1118 Raintree Circle, Culver City CA 90230. (213) 839-0324.

For Sale: SuperELF assem. hi-low disp. hardwood case, Super Expansion Board unassem. (4K-RAM, 1K-ROM mon., cass.—TTY—RS-232 1Ps). Also, rf ch3, complete docum. all iss. Questdata; $125. Read KB Apr 79, p 100. John D. Johnson, 108 Bunn Dr., Rocky Mount NC 27801. (919) 443-1654.

CALENDAR

Boston MA

Northeast Personal & Business Computer Show at Hynes Auditorium, Prudential Center, Boston MA, Friday, September 28, through Sunday, September 30, 1979. Show hours: Friday and Saturday, noon to 10 PM; Sunday, noon to 6 PM. General adult admission (including seminars and lectures), $5. Northeast Exposition, PO Box 678, Brookline Village MA 02147. (617) 522-4467. Press info: Jane Badgers & Co., (617) 244-5305, 523-5563.

Philadelphia PA

IECI '80, the Sixth Annual Conference and Exhibit on Industrial and Control Applications of Microprocessors, will return to Philadelphia's Sheraton Hotel next March 17-19, 1980. The Industrial Electronic and Control Instrumentation Society sponsors IECI '80. *Call for Papers.* Submit 10 copies of proposed paper in extended summary form, 500-600 words, and 40-word abstract to: H. T. Nagle, Jr., Electrical Engineer, Auburn University, Auburn AL 36830, (205) 826-4330. Deadline: September 14, 1979; Notification of Acceptance: October 14, 1979; Final Manuscripts: January 11, 1980.

Please have calendar announcements in our hands at least three months before the month of the issue in which you want the announcement to appear. Keep announcements short and to the point, and send them to the attention of the managing editor to assure their finding their way to the editorial department. Thank you.

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At last a **Full Size** Basic for 1802 systems. A complete function Basic including two dimensional arrays, string variables, floating point, arithmetic and 32 bit signed integer arithmetic (10 digit accuracy) with I/O routines. Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now for immediate delivery. ROM versions coming soon with exchange privilege allowing credit for cassette version.

Super Basic on Cassette **$40.00**

Tiny Basic Source now available **$19.00**

S-100 Slot Expansion. Add 3 more S-100 slots to your Super Expansion Board or use as a 4 slot S-100 Mother Board. Board without connectors **$9.95.**

Coming Soon: High resolution alpha/numerics with color graphics expandable up to 256 x 192 resolution for less than **$100**. Economical versions for other popular 1802 systems also.

16K Dynamic RAM board expandable to 32K for less than **$150.**

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00**, on ROM **$38.00**, original Elf kit board **$14.95.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed**. EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. A Godbout 8K RAM board is available for $135.00. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

The **Power Supply Kit** for the Super Expansion Board is a 5 amp supply with multiple positive and negative voltages $29.95. Add $4.00 for shipping. Prepunched frame $7.50. Case $10.00. Add $1.50 for shipping.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12 option. ±5v, ±12v are regulated. Kit $29.95. Kit with punched frame $37.45. Woodgrain case $10.00.

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, IC, crystal, resistors, capacitors and trimmer.

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00. Power supply assy. in case $60.00. AIM 65 in thin briefcase with power supply $485.00.

Not a Cheap Clock Kit $14.95

Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. Orange displays also avail. **Same kit w/.80" displays.** Red only. **$21.95** Case **$11.75**

Video Modular Kit $8.95

Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

S-100 Computer Boards

8K Static RAM Kit Godbout	$135.00
16K Static RAM Kit	265.00
24K Static RAM Kit	423.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
8K/16K Eprom Kit (less PROMS)	**$89.00**
Video Interface Kit	**$139.00**
Motherboard **$39.** Extender Board	**$8.99**

79 IC Update Master Manual $35.00

Complete IC data selector, 2500 pg. master reference guide. Over 50,000 cross references. Free update service through 1979. Domestic postage $3.50. 1978 IC Master closeout $19.50. No foreign orders.

Auto Clock Kit $17.95

DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

Stopwatch Kit $26.95

Full six digit battery operated. 2-5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instructions.

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$34.50**

Hickok 3½ Digit LCD Multimeter

Batt/AC oper. 0.1mv-1000v. 5 ranges. 0.5% accur. Resistance 6 low power ranges 0.1 ohm-20M ohm. DC curr. .01 to 100ma. Hand held, ½" LCD displays, auto zero, polarity, overrange. **$69.95.**

Digital Temp. Meter Kit $39.95

Indoor and outdoor. Switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Beautiful woodgrain case w/bezel **$11.75**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
BankAmericard and Master Charge accepted.
Shipping charges will be added on charge cards.

FREE: Send for your copy of our NEW 1979 QUEST CATALOG. Include 28¢ stamp.

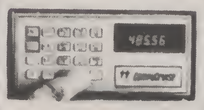
✓ Reader Service—see page 195

Reader Service—see page 179

COMPUCRUISE

Put a computer in your car, which gives you the most effective and functional cruise control ever designed, plus complete trip computing, fuel management systems, and a remarkable accurate quartz crystal time system.

So simple a child can operate, the new CompuCruise combines latest computer technology with state-of-the-art reliability in a package which will not likely be available on new cars for years to come • Cruise Control • Time, E.T., Lap Timer, Alarm • Time, Distance, Fuel to Arrival • Time, Distance, Fuel to Empty • Time, Distance and Fuel on Trip • Current or Average MPG, GPH • Fuel Used, Distance since Fillup • Current and Average-Vehicle Speed • Inside, Outside or Coolant Temperature • Battery Voltage • English or Metric Display. $199.95

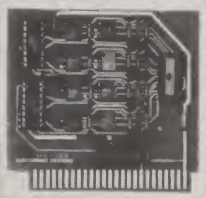


FLOPPY DISK STORAGE BINDER

This black vinyl three-ring binder comes with ten transparent plastic sleeves which accommodate either twenty, five-inch or ten, eight-inch floppy disks. The plastic sleeves may be ordered separately and added as needed. A contents file is included with each sleeve for easy identification and organizing. Binder & 10 holders $14.95 Part No. B800; Extra holders 95¢ each. Part No. 800

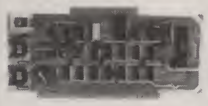
OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II

There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection.
Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.



TIDMA

• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only $35.00 Part No. 112, with parts $110 Part No. 112A



SYSTEM MONITOR

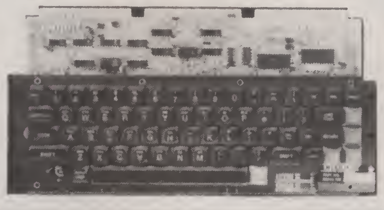
8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

How to Profit from Your Personal Computer: Professional, Business, and Home Applications

"... useful reading for the small businessman, contemplating a computer, or for the personal computer advocate contemplating a business application." Kilobuad. By T G. Lewis. HAYDEN 78-2780. $8 95

ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $135.00.



ASCII KEYBOARD

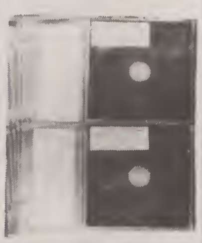
53 Keys popular ASR-33 format • Rugged G-10 P. C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $229.95. Part No. TA 1000C

DISK JACKET™

Made from heavy duty .0095 matte plastic with reinforced grommets. The minidiskette version holds two 5-1/4 inch diskettes and will fit any standard three ring binder. The pockets to the left of the diskette can be used for listing the contents of the disk. Please order only in multitudes of ten. $9.95/10 Pack.



INTERNATIONAL MICROPROCESSOR DICTIONARY

English, French, Danish, German, Italian, Hungarian, Norwegian, Polish, Spanish, Swedish. 10 languages, 28 pp. SYBEX. Ref. IMD. $4.95

TTL COOKBOOK

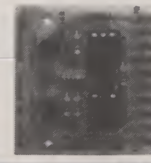
Bk 1063 — by Don Lancaster. Explains what TTL is, how it works, and how to use it. Discusses practical applications, such as a digital counter and display system, events counter, electronic stopwatch, digital voltmeter and a digital tachometer. $8.95

MICRO-PROCESSOR LEXICON — ACRONYMS AND DEFINITIONS

Bk 1040 — compiled by the staff of SYBEX, is a convenient reference in pocket-size format. Sections include acronyms and definitions, part numbers and their definitions, S-100 signals, RS232 signals, IEEE 499 signals, microcomputers and microprocessors. JETDS summary (military) and a code conversion table. $2.95*

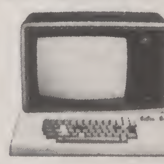
RS-232/20mA INTERFACE

This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.



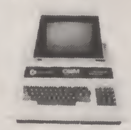
COMPUCOLOR II

Model 3, 8K $13.95, Model 4, 16K $15.95, Model 5, 32K $18.95. Prices include color monitor, computer, and one disk drive.



PET COMPUTER

With 32K & monitor - $1195. Dual Disk Drive - $1195.



apple II

16K - $1095, 32K $1195, 48K - $1293. Disk & cont. $589

6502 APPLICATIONS BOOK Z80 APPLICATIONS BOOK*

This book will teach you how to connect a board to the outside world and implement practical applications for the 6502, (or Z80). Applications range from home control (a complete alarm system, including heat sensor), to industrial applications. You will learn techniques ranging from simulated traffic control to analog-digital conversion. All experiments can be realized with a minimum of external (low-cost) components. They are directly applicable to any 6502-based board such as SYM, KIM, AIM 65. This book also studies in detail input-output techniques and components, and is the logical continuation of C202 (or C280). By Rodney Zaks. SYBEX. 6502: Ref. D302; Z80: Ref D380. Each $12.95

T.V. INTERFACE

• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple • Power required is 12 volts AC C.T., or +5 volts DC • Board only $7.60 part No. 107, with parts $13.50 Part No. 107A

PARALLEL TRIAC OUTPUT BOARD FOR APPLE II

This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U. S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U. S. dollars. Dealer inquiries invited. 24 hour order line (408) 226-4064. E21

Send for FREE Catalog . . . a big self-addressed envelope with 41¢ postage gets it fastest!

ELECTRONIC SYSTEMS Dept. KB, P. O. Box 21638, San Jose, CA USA 95151

TRS-80 E.S. SERIAL I/O

• Can input into basic • Can use LLIST and LPRINT to output, or output continuously • RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line • Requires +5, -12 VDC • Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010 C. No connectors provided, see below.

EIA/RS-232 connector Part No DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9.

3' ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No 3CAB40.

MODEM

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 Ω speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board only $7.60 Part No. 109, with parts $27.50 Part No. 109A

APPLE II* SERIAL I/O INTERFACE

Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Also watches DTR • Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

T.V. TYPEWRITER

• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A

TAPE INTERFACE

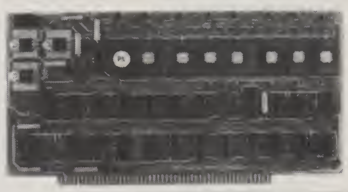
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $27.50 Part No. 111A

DISKETTES

Box of 10, 5" $29.95, 8" $39.95.
Plastic box, holds 10 diskettes, 5" - $4.50, 8" - $6.50.

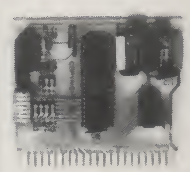
8K EPROM PIICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. • S-100 bus compatible • Room for 8K bytes of EPROM non-volatile memory (2708's). • On-board PROM programming • Address relocation of each 4K of memory to any 4K boundary within 64K • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software available • Solder mask both sides • Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.



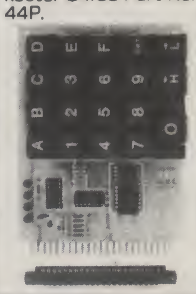
UART & BAUD RATE GENERATOR

• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P



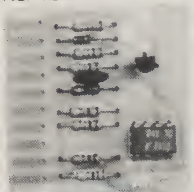
HEX ENCODED KEYBOARD E.S.

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A. 44 pin edge connector $4.00 Part No. 44P.



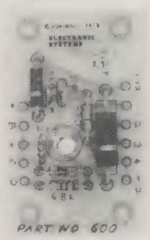
RS-232/ TTL INTERFACE

• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only $4.50 Part No. 232, with parts $7.00 Part No. 232A 10 Pin edge connector $3.00 Part No. 10P



RS-232/TTY INTERFACE

This board has two active circuits, one converts RS-232 to 20mA, and the other converts 20mA to RS-232. Requires +12 and -12 volts. Board only $4.50 Part No. 600, with parts $7.00 Part No. 600A.



WAMECO PRODUCTS WITH ELECTRONIC SYSTEMS PARTS

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remex 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included). PCBD $42.95

FPB-1 Front Panel. (Finally) IMSAI size hex displays. Byte or instruction single step. PCBD $42.95

MEM-1A 8Kx8 fully buffered, S-100, uses 2102 type RAMS. PCBD .... $24.95, $168 Kit

QMB-12 MOTHER BOARD, 13 slot, terminated, S-100 board only .... $34.95 $89.95 Kit

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD .. $25.95 $89.95 Kit

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD .... $25.95, $60.95 Kit

EPM-1 1702A 4K EPROM card PCBD .... $25.95 $49.95 with parts less EPROMS

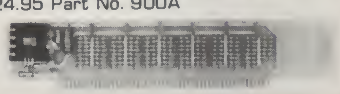
EPM-2 2708/2716 16K/32K EPROM card PCBD .... $24.95 $49.95 with parts less EPROMS

QMB-9 MOTHER BOARD. Short Version of QMB-12. 9 Slots PCBD .... $30.95 $67.95 Kit

MEM-2 16Kx8 Fully Buffered 2114 Board PCBD .... $25.95, $269.95 Kit

S-100 BUS ACTIVE TERMINATOR

Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A



DC POWER SUPPLY

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U. S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U. S. dollars. Dealer inquiries invited. 24 hour order line (408) 226-4064.

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ELECTRONIC SYSTEMS Dept. KB, P. O. Box 21638, San Jose, CA USA 95151

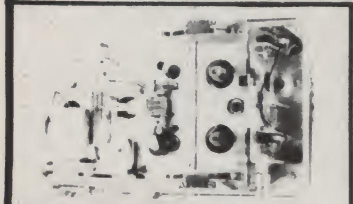
✓ *Reader Service—see page 195*

Your source for electronic surplus bargains.

9" VIDEO MONITOR REAL SHARP........ Motorola - R.U.E. - Runs on 12VDC. .8A. scans vert., Rotate yoke scans horiz. SOLD AS IS -You change & save. Qty. Ltd. Mot. No. 69VP106-Q01 Size; 9"Wx8½Dx8¼H. with data. Sh. Wt. 15 lbs. D9130269 $49.88

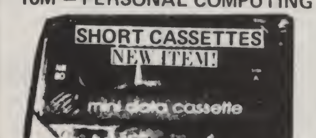
OP. AMP/LOGIC P.S. ±15V1A,+5V5A. Size 13"L x 7"W x 3"H Sh. Wt. 10 lbs. Mfg. by Elasco D9130270 $24.88

COMPUTER INTERFACE
We have obtained a few boards(pair), that were used to interface with a computer from a 9" video display monitor with a keyboard. (alpha/numeric) Looka like the boards require +5V, ±15V to operate from. We have some Data which we supply. At our low price it looks like a good deal to learn something from or to use on your own CPU Interface etc. Sh. Wt. 10 lbs. Size:15"x15" aprox. 9130271 $16.88/set $45.00/3 sets



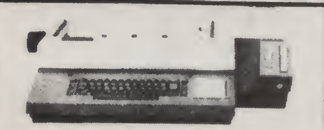
COMPUTER CASSETTE RECORDERS
Equal to Conrac Md. No. C20A-D. These are used & with parts missing, But with circuit cards & stuff. Has 3 siemans motors No. 1AD3101 - 24 volt.Tape read/write speeds 1.5 to 15 inches/sec. Some data included—List price $225.00 ea. Yours for only $48.88 ea.-
Sh. Wt. 5 lbs. 9K30279 $48.88
4 for $188.88 9K30279 $188.88/4

10M – PERSONAL COMPUTING



Use these short cassettes for only one program per cassette. These 10 minute running time are ideal for all programs — List Price $1.50 each. Yours for only $1.50 for 2. Use in the TRS-80, PET & SWT units. Priced to sell!

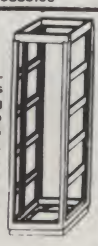
Sh. Wt. 6 oz.	9C0043	$1.50/2
8 for $5.00	9C0043	$5.00/8
20 for $10.00	9C0043	$10.00/20



IBM/NOVA SELECTRIC

Both ASCII & IBM codes available. Complete ready to go with Microcomputer Interface software & hardware (RS-232 Connector.) Cassett drive premits up to 2400 Baud Data Transfer rate as well as memory typewriter, & use as data entry devise for office use. Comes with Wide carriage, interchangeable balls, units cleaned,& adjusted, working.. F.O.B. Peabody.
IBM Corres.Code.....8A30310 $748.00
ASCII code.............8A30311 $888.00

EQUIPTO RACK CABINET- . . . Size: 24"x 24"x 68" with rails on front and back for mounting equipment on 19" centers. No doors or sides. List price $185 You pay only $50! Qty ltd. Sh. Frt. coll. Sh.Wt. 75 lbs. 80B20469 $50.00 ea. Shipped freight collect. Sh. Wt. 75 lbs. 80B20469 $50.ea.



CONRAC VIDEO DISPLAY MONITORS
Used—bonded face CRT. Requires rewiring, as these were xternally 'synced.. Details for conversion to internal sync and modifications included. sold AS IS. Green phosphor-coated. QTY LTD Cost new $200
Sh. wt. 25 lbs . . . . . 913B0154 . . . $38.88

DATA INPUT/OUTPUT TERMINAL

Use this unit to build your own computer I/O station, or to build a compact scope, or simply to take apart for components inside. COMPLETE UNIT:
Sh. wt. 35 lbs . . . . 6NB60336 . . . . $39.88

ALSO AVAILABLE IN PARTS:
Use same order no. as above
A.) 3" CRT w/ hi-volt supply of +3315VDC & –1730VDC, and low-volt supply of +440V, +225V, +1.2V, +0.6V, 6.3VDC & 6.3VAC. Includes ramp generator card & some drive circs.
Sh. wt. 15 lbs . . . . 6NB60336(A) . . . $19.88
B.) 50 Block Keyboard w/ diode matrix on 2 cards.
Sh. wt. 5 lbs . . . . 6NB60336(B) $9.88
C.) Desk-top, slope-front case suitable for up to 11" CRT. Overall 10½"W x 16"D x 9"H.
Sh. wt. 6NB60336(C) $9.88
D.) 3-Wire Line Cord, brown, 7' long.
Sh. wt. 2 lb . . . . . . 6NB60336(D) $1.25
E.) 14-Wire Connector
Sh. wt. 3 lb . . . . 6NB60336(E) $2.88
F.) Tech Manual covering operating procedure, theory, dissassembly/reassembly, etc.
Sh. wt. 8 oz 6NB60336(F) .$1.25 w/ complete unit, or $3.88 separately.

FILTER – MICRO PROCESSOR POWER LINE

These super items are useful to filter RFI, line noise or line spikes from interfering or damaging your micro. This unit contains a 3-wire line cord & 3-wire outlet, some caps & wound toroids. Good for 10-amps. List price was $24.95. Yours for only $6.88 each. Great to use in your CB base units, micro processors, or any other sensitive electronic equipment.
Sh. Wt 8 oz. . . . 9R0135. . . . . . . $6.88
6 for $38.88 . . . . 9R0135 . . . . $38.88/6

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WALL MOUNTS - Good for B & W, color T.V.'s, projection and C.C. T.V.'s, monitors, cameras, etc. 2 types avail.: chrome plated and brown painted units. Use in motels, labs, hosp., classrms, etc. Chrome plated takes 17" col. T.V. Size: 20" x 18" x 15". Cost over $30 to make. QTY LTD
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Brn Painted takes 18" col. T.V. Size: 22" x 22" x 15" QTY LTD
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Both Adjustable thru approx. 30° horiz

40 CH. C.B.. CHASSIS HI-GAIN C.B Synthesized P.C. Board Ass'y & Chassis complete or nearly so they have not been type accepted- can be used for ham's 10 meter rigs etc. see 73's fall 78 issu, on data, with typical schem. inc. 2 types avail.
Trunk Mount Remote 9AS0251 $9.88
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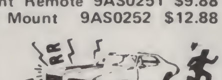
CB



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•Ult Sonic Mot Det.	8D30336	$49.50
•Touch Switch Al	8MI0475	$6.88
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•Al. Wireless Xmitter	8S20110	$14.88
•Al. Wireless Rec.	8S20111	$14.88
• " " 6" Bell Rec.	9S20198	$12.88
•1½" Light Sen. Sw.	7C70281	$4.88
•Patio Door Al.	8S20251	$1.50
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•Door/Window Grd.	8MI10512	$2.88
•CB Alarm	R8K30263	$4.38
•Elec. Bike Al.	7S70456	$7.50

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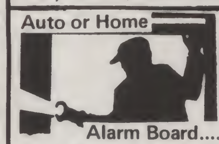
•Latching Sw. 15A	8F20204	$2.88
•Al. Bd. Latch	8K30267	$2.88
•Key Sw. (SPST)	9D0157	$4.88
•Key Sw. (SP3T)	R7C70103	$1.25

Auto or Home



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PROTECT YOUR VALUABLES

Neat new closed-circuit alarm board will latch a relay if circuit is opened. This unit operates on 12VDC, and at such a low price makes a perfect compact alarm component. With data.
Sh. wt. 6 oz . . . . . .8K30267. . . . . $2.88 ea.
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Hamamatsu Corp R372 type tube 1 1/8" dia, 9 stages, spectral response 1850 7300, wavelength of max response 3400 Angstroms. uv glass window, bialkiac photo cathode material type char @ 25° C., anode to cathode voltage 1000 VDC, cathode sensitivity -cathode luminous (uA/Lumens–40), anode sensitivity--anode luminous @ 0 cps (A/Lumens--120), anode radiant (A/W) 1.4 x 10^5 max. Anode dark current (uA) –0.05. Newly boxed. Sh wt. 8 oz
9V00256 . . . . $10.00 ea.
3 for $27.00

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5 Volt, 1 Amp Power Supply w/ 74LS Chips

New game board just off production run. These boards contain a 5V, 1A power supply (less Xformer), a TV-computer interface modulator, plus 16 or 20 74LS ICs and a handful of some other components. Complete with schematic for TV Tennis, Handball, etc. Instructions are included for using the power supply.
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3 for $17.88
Xformer for above power supply:
Sh. wt. 1 lb . . . . .8T30339. . . . . .$1.25 ea
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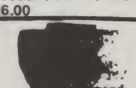
COMPUTER SURPLUS



COMPUTER STUFF
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•9"Vid Mon (Conrac)You repair & save Data supplied 913B0154 $38.88
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•5" Muffin fan 8T0532 $8.88
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Kit 450 NSEC $259.95

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FORMERLY CYBERCOM/SOLID STATE MUSIC.

PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies require textool sockets. Kit $124.95

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MB-7 16KX8, Static RAM uses µP410 Protection, fully buffered Kit $299.95

MB-8A 2708 EROM Board, S-100, 8K8X or 16Kx8 kit without PROMS $75.00 ....PCBD $28.95

MB-9 4KX8 RAM/PROM Board uses 2112 RAMS or 82S129 PROM kit without RAMS or PROMS $72.00

IO-2 S-100 8 bit parallel /IO port, ⅔ of boards is for kludging. Kit ....$46.00 PCBD........ $26.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports.
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PCBD.......... $42.95 KIT..........$135.95

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QM-12 MOTHER BOARD, 13 slot, terminated, S-100 board only $34.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD $26.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD $23.95

EPM-1 1702A 4K Eprom card PCBD $25.95

EPM-2 2708/2716 16K/32K
EPROM CARD PCBD $25.95

QM-9 MOTHER BOARD, Short Version of QM-12.
9 Slots PCBD $30.95

MEM-2 16K x 8 Fully Buffered
2114 Board PCBD $26.95

8080A	$9.95	5101-8P	$ 8.40
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SEPT SPECIAL SALE ON PREPAID ORDERS
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8KX8 RAM Fully buffered 450 NSEC. 2.5 amp typical assembled parts may be unmarked or house numbered.
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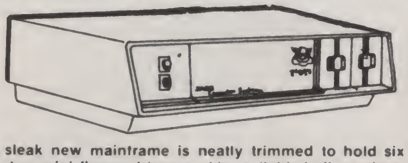
JADE Computer Products

THE PIGGY MAINFRAME



This sleak new maintrame is neatly trimmed to hold six S-100 boards, two mini-floppy drives, and is available in five colors. Power requirements: 115/220 VAC, 50/60 HZ. Weight: 27 lbs. (with drives). Dimensions: 21.375" Wide X 8.4" High X 15.875" Deep. Power Supply: 8 volts at 18 Amps unregulated. 16 volts at 3 amps ureguIated. - 16 volts at 3 amps unregulated. 5 volts at 3 amps regulated. 12 volts at 3 amps regulated.

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THE PIGGY (Without Drives) **$475.00**

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Includes gold plated fingers, S-100 size, holds 72-16 pin dips, accomodates all 8 thru 40 pin dip packages.
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Everything a person needs to add 16K of memory. Chips come neatly packaged with easy to follow directions. In minutes your machine is ready for games and more advanced software.

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6502 — based single board computer with keyboard/display, KIM-1 hardware compatible, complete documentation.

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2 Serial & 2- Parallel I O Ports. S-100 with full handshaking

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Kit- (450ns)	$250.00
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DYNAMIC RAM BOARDS EXPANDABLE TO 64K

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Uses 4115 (8K x 1, 250ns) Dynamic RAM's, can be expanded in 8K increments up to 32K.

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4115 SALE 8 for $39.95

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STATIC RAM BOARDS

JADE 8K

Kits:	450ns	$125.95
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Bare Board:		$ 25.00

16K — Uses 2114's (low power)

Assembled & Tested:

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16K with memory management

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32K Static

Assembled & Tested:

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An S-100 single board computer Z-80 CPU with 1024 bytes of RAM, 8 to 32K bytes of PROM Serial I O port

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Assembled	$369 95

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Plugs into your IMSAI or ALTAIR 4 extra status lines 37 page manual included. 4 extra control lines

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8080 A	$10 00
8085	$23 00
TMS9900TL	$49 95
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8212	$2 90
8214	$4 65
8216	$2 75
8224 (2MHz)	$4 30
8224-4 (4MHz)	$9 95
8226	$2 75
8228	$6 40
8238	$6 40
8243	$8 00
8251	$7 50
8253	$20 00
8255	$6 40
8257	$18 00
8259	$18 00
8275	$51 20
8279	$17 70
USRT	
S2350	$10 95
UARTS	
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AY5 1014A	$8 25
TR1602B	$5 25
TMS6011	$5 95
IM6403	$9 00
BAUD RATE GENERATORS	
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6862P	$12 00
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2513 Lower (1 12 5)	$6 75
2513 Upper (5 volt)	$9 75
2513 Lower (5 volt)	$10 95
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MCM6571A down scan	$10 95
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2708	$12 95
2716 (5 12)	$49 00
2716 (5v)	$49 00
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2104 4096	$4 00
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2101-1	$2 95	$2 60
2111-1	$3.25	$3 00
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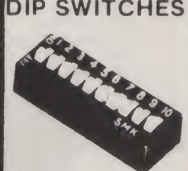
Special Package Price: $599.00
AIM-65 (4K), Power Supply, Case, and 8K BASIC ROM

DIP SWITCHES



Part No	positions	1-9
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SWD-104	4	$1 20
SWD-105	5	$1 24
SWD-106	6	$1 28
SWD-107	7	$1 30
SWD 108	8	$1 34
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SWD-110	10	$1 38

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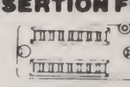
*ZERO INSERTION FORCE sockets



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Features Include: ■ S-100 Compatible, available in 2MHz or 4MHz versions. ■ On-board 2708, 2716, 2516, or 2532 EPROM can be addressed on any 1K, 2K, or 4K boundary, with power-on jump to EPROM. ■ On-board EPROM may be used in SHADOW mode, allowing full 64K RAM to be used. ■ Automatic MWRITE generation if front panel is not used. ■ On-board USART for synchronous or asynchronous RS232 operation (on-board baud rate generator). ■ Reverse-channel capability on USART allows use with buffered peripherals or devices with "not-ready" signal.

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Kit: CPU-30201K, 2 lbs .. $159.95
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- Controls up to 8 drives
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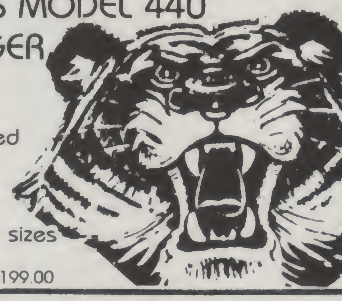

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8" DISK CABLE KIT: Same as WCA-5031K except controller end of signal cable uses "Header" type connector, e.g., for Tarbell Controller.
WCA-5032K $38.95

SIGNAL CABLE ONLY: For one 5 1/4" drive to edge type controller connector (e.g., TRS-80 to Vista Disk Drive).
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JADE FLOPPY DISK (Tarbell board)

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FOR TRS—80
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Includes disk drive, power supply, regulator board, and compact case. The V-80 offers 23% more storage capacity. Simply take it out of the box, plug in the cable, and it's ready to run. Requires 16K Level II, expansion interface.

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74LS03	.29	74LS54	.29	74LS155	.89
74LS04	.35	74LS55	.29	74LS157	.89
74LS05	.35	74LS73	.45	74LS160	1.15
74LS08	.29	74LS74	.45	74LS161	1.15
74LS09	.35	74LS75	.59	74LS162	1.15
74LS10	.29	74LS76	.45	74LS163	1.15
74LS11	.75	74LS78	.49	74LS164	1.25
74LS13	.59	74LS83	.89	74LS175	.99
74LS14	1.25	74LS85	1.25	74LS181	2.49
74LS15	.35	74LS86	.45	74LS190	1.15
74LS20	.29	74LS90	.59	74LS191	1.15
74LS21	.35	74LS92	.75	74LS192	1.15
74LS22	.35	74LS93	.75	74LS193	1.15
74LS26	.35	74LS95	.99	74LS194	1.15
74LS27	.35	74LS96	1.15	74LS195	1.15
74LS28	.35	74LS107	.45	74LS253	.99
74LS30	.29	74LS109	.45	74LS257	.89
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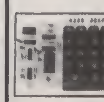
EXCITING NEW KITS

NEW JE600 HEXADECIMAL ENCODER KIT



FEATURES:
- Full 8 bit latched output for micro-processor use
- 3 User Define keys with one being bi-stable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin IC connector
- Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

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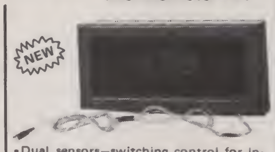
JE600 . . . . $59.95

Hexadecimal Keypad only $10.95

Digital Thermometer Kit

NEW



- Dual sensors—switching control for indoor/outdoor or dual monitoring
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- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
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- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

JE300 . . . .$39.95

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XC556G	green	4/$1		XC209G	green	4/$1	
XC556Y	yellow	4/$1		XC209Y	yellow	4/$1	
XC556C	clear	4/$1					
	.200" dia.				.185" dia.		
XC22R	red	5/$1		XC526R	red	5/$1	
XC22G	green	4/$1		XC526G	green	4/$1	
XC22Y	yellow	4/$1		XC526Y	yellow	4/$1	
	.170" dia.			XC526C	clear	4/$1	
MV10B	red	4/$1			.190" dia.		
	.085" dia.			XC111R	red	5/$1	
MV50	red	6/$1		XC111G	green	4/$1	
				XC111Y	yellow	4/$1	
				XC111C	clear	4/$1	

INFRA-RED LED
1/4"x1/4"x1/16" flat
5/$1

TIMEX T1001 LIQUID CRYSTAL DISPLAY CLASS II

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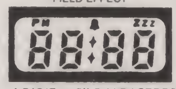

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2.00" X 1.20" PACKAGE
INCLUDES CONNECTOR

T1001-Transmissive $7.95

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DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D D	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.99	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.99	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	1.30
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	2.10
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	2.10
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.49
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7 seg. C.A. LED driver	1.50

CLOCK CHIPS

MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
MM5841	9.95

MOTOROLA

MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$.17	.16	.15	22 pin LP	$ .37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$.27	.25	.24	28 pin ST	$ .99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$.30	.27	.24	24 pin SG	$ .70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.65	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin WW	$.39	.38	.31	22 pin WW	$ .95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	.43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	50 PCS	$1.75
ASST. 2	5 ea	68 OHM 180 OHM	82 OHM 220 OHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 OHM	50 PCS	1.75
ASST. 3	5 ea	470 OHM 1.2K	560 OHM 1.5K	680 OHM 1.8K	820 OHM 2.2K	1K 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50 PCS	1.75
ASST. 5	5 ea	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50 PCS	1.75
ASST. 6	5 ea	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50 PCS	1.75
ASST. 7	5 ea	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

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TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.95

ICM CHIPS

ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

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MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alphanumeric Control Character Generator	13.50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.50
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block (Special)	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
2/99¢

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power - Programmable
3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55	JE2206KA	14.95	XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	2.85
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.30	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.39	XR2212	4.35	XR4739	1.15
XR1489	1.39	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
				1N4002	100 PIV	1 AMP	12/1.00
1N746	3.3	400m	4/1.00	1N4003	200 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N752	5.6	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N757	9.0	400m	4/1.00	1N3600	50	200m	6/1.00
1N759	12.0	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965	15	400m	4/1.00	1N4305	75	25m	15/1.00
1N5232	5.6	500m	.28	1N4734	5.6	1w	.28
1N5234	6.2	500m	.28	1N4735	6.2	1w	.28
1N5235	6.8	500m	.28	1N4736	6.8	1w	.28
1N5236	7.5	500m	.28	1N4738	8.2	1w	.28
1N5242	12	500m	.28	1N4742	12	1w	.28
1N5245	15	500m	.28	1N4744	15	1w	.28
1N456	25	40m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N458	150	7m	6/1.00	1N1184	100 PIV	35 AMP	1.70
1N485A	180	10m	5/1.00	1N1185	150 PIV	35 AMP	1.70
1N4001	50 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
				1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369	5/1.00	MPS3705	5/1.00	2N5087	4/1.00
2N2369A	4/1.00	2N3706	5/1.00	2N5088	4/1.00
MPS2369	5/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2484	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2906	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2907	5/1.00	2N3724A	.65	PN5138	5/1.00
PN2907 Plastic	7/1.00	2N3725A	1.00	2N5139	5/1.00
2N2925	5/1.00	2N3772	2.25	2N5210	5/1.00
MJE2955	1.25	2N3823	1.00	2N5449	3/1.00
2N3053	2/1.00	2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
10 pf	.05	.04	.03	.001μF	.05	.04	.035
22 pf	.05	.04	.03	.0047μF	.05	.04	.035
47 pf	.05	.04	.03	.01μF	.05	.04	.035
100 pf	.05	.04	.03	.022μF	.06	.05	.04
220 pf	.05	.04	.03	.047μF	.06	.05	.04
470 pf	.05	.04	.035	1μF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	15/25V	.63	.50	.40
1.0/35V	.28	.23	.17				
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

Transistor Checker

— Completely Assembled —
— Battery Operated —

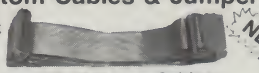
The ASI Transistor Checker is capable of checking a wide range of transistor types, either "in circuit" or out of circuit. To operate, simply plug the transistor to be checked into the front panel socket, or connect it with the alligator clip test leads provided. The unit safely and automatically identifies low, medium and high power PNP and NPN transistors. Size: 3¾" x 6¼" x 2"
"C" cell battery not included.

ON SALE!

Trans-Check $19.95 ea.

Custom Cables & Jumpers

NEW NEW



DB 25 Series Cables

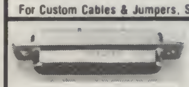
Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft	2-DP25P	$15.95 ea
DB25P-4-S	4 Ft	1-DP25P/1-25S	$16.95 ea
DB25S-4-S	4 ft	2-DP25S	$17.95 ea

Dip Jumpers

DJ14-1	1 ft	1-14 Pin	$1.59 ea
DJ16-1	1 ft	1-16 Pin	1 79 ea
DJ24-1	1 ft	1-24 Pin	2.79 ea
DJ14-1-14	1 ft	2-14 Pin	2.79 ea
DJ16-1-16	1 ft	2-16 Pin	3 19 ea
DJ24-1-24	1 ft	2-24 Pin	4 95 ea

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

CONNECTORS



25 Pin-D Subminiature

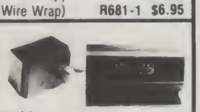
DB25P (as pictured)	PLUG (Meets RS232)	$2.95
DB25S	SOCKET (Meets RS232)	$3.50
DB51226-1	Cable Cover for DB25P or DB25S	$1.75

PRINTED CIRCUIT EDGE-CARD

156 Spacing-Tin-Double Read-Out — Bifurcated Contacts — Fits 054 to 070 P C Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100 (.100 Spacing)	PINS (Wire Wrap)	$6.95
50/100 (.125 Spacing)	PINS (Wire Wrap) R681-1	$6.95

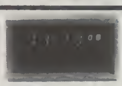
4-Digit Clock Kit



- Bright .357" ht. red display
- Sequential flashing colon
- 12 or 24 hour operation
- Extruded aluminum case (black)
- Pressure switches for hours, minutes & hold functions
- Includes all components, case and wall transformer
- Size: 3¼ x 1⅜ x 1¼

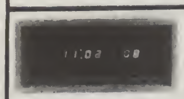
JE730 .... $14.95

Jumbo 6-Digit Clock Kit



- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾ x 3⅛ x 1¾

JE747 .... $29.95

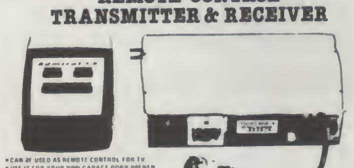


- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701

6-Digit Clock Kit $19.95

REMOTE CONTROL TRANSMITTER & RECEIVER



- CAN BE USED AS REMOTE CONTROL FOR TV
- USE IT FOR YOUR OWN GARAGE DOOR OPENER
- TRANSMITS BETWEEN 38kHz AND 41.5kHz
- THOUSANDS OF USES FOR REMOTE CONTROL APPLICATIONS
- TRANSMITTER USES A 1.5V BATTERY
- SCHEMATIC INCLUDED

$19.95

Digital Stopwatch Kit

- Use Intersil 7205 Chip
- Plated thru double-sided P.C. Board
- LED display (red)
- Times to 59 min. 59.59 sec. with auto reset
- Quartz crystal controlled
- Three stopwatches in one: single event, split (cummulative) & taylor (sequential timing)
- Uses 3 penlite batteries
- Size: 4.5" x 2.15" x .90"

JE900 $39.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$ 9.95
8212	8-Bit Input/Output	3 25
8214	Pnority Interrupt Control	5 95
8216	Bi-Directional Bus Orivei	3 49
8224	Clock Generator/Orıver	3 95
8226	Bus Orivei	3.49
8228	System Controller/Bus Oriver	5.95
8238	System Controller	5 95
8251	Prog. Comm. 1/0 (USART)	7.95
8253	Prog Interval Timer	14 95
8255	Prog. Periph 1/0 (PPI)	9 95
8257	Prog. OMA Control	19 95
8259	Prog. Interrupt Control	19 95

6800/6800 SUPPORT OEVICES

MC6800	MPU	$14 95
MC6802CP	MPU with Clock and Ram	24 95
MC68t0API	128X8 Static Ram	5.95
MC6821	Periph Inter. Adapt (MC6820)	7 49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14 95
MC6850	Asynchronous Comm. Adapter	7 95
MC6852	Synchronous Senal Oata Adapt.	9 95
MC6860	0-600 bps Digital MODEM	12 95
MC6862	2400 bps Modulator	14 95
MC6880A	Quad 3-State Bus Trans (MC8T26)	2.25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$t9 95
Z80A(780-1)	CPU	24 95
CDP1802	CPU	19 95
2650	MPU	19 95
6502	CPU	11 95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19 95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49 95

SHIFT REGISTERS

MM500H	Oual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	50
MM504H	Oual 16 Bit Static	50
MM506H	Dual 100 Bit Static	.50
MM510H	Oual 64 Bit Accumulator	50
MM5016H	500/512 Bit Oynamic	89
2504T	1024 Dynamic	3 95
2518	Hex 32 Bit Static	4 95
2522	Oual 132 Bit Static	2 95
2524	512 Static	99
2525	1024 Dynamic	2 95
2527	Oual 256 Bit Static	2 95
2528	Oual 250 Static	4 00
2529	Dual 240 Bit Static	4 00
2532	Quad 80 Bit Static	2 95
2533	1024 Static	2 95
3341	Fifo	6 95
74LS670	4X4 Register File (TriState)	2 49

UART'S

A-Y-5-t013	30K BAUD	5 95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7 50
M-CDP1802	User Manual	7 50
M-2650	User Manual	5.00

ROM'S

2513(2140)	Character Generator(upper case)	$9 95
2513(3021)	Character Generator(lower case)	9 95
2516	Character Generator	10 95
MM5230N	2048-Bit Read Only Memory	1.95

RAM'S

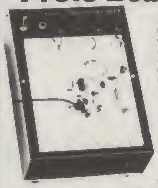
1101	256X1	Static	$1 49
1103	1024X1	Oynamic	99
2101(8101)	256X4	Static	3 95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1 95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MDS	4.95
2114	1024X4	Static 450ns	9 95
2114L	1024X4	Static 450ns low power	10 95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	1t 95
5101	256X4	Static	7.95
5280/2107	4096Xt	Dynamic	4 95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4 95
93421	256Xt	Static	2 95
UPD4t4 (MK4027)	4K	Dynamic 16 pin	4 95
UPD4t6 (MK4116)	16K	Dynamic 16 pin	9 95
TMS4044-45NL	4K	Static	14 95
TMS4045	1024X4	Static	14 95
2117	16,384X1	Dynamic 350ns (house marked)	9 95
MM5262	2KX1	Dynamic	4/1.00

PROM'S

1702A	2048	FAMDS	$5.95
2716INTEL	16K*	EPROM	59 95
TMS2516	16K*	EPROM	49 95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89 95
2708	8K	EPROM	10 95
2716 T.I	16K**	EPROM	29 95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMDS	14 95
6301-1(76t1)	1024	Tristate Bipolar	3 49
6330-1(7602)	256	Open C Bipolar	2 95
82S23	32X8	Open Collector	3 95
82S115	4096	Bipolar	19 95
82S123	32X8	Tristate	3 95
74186	512	TTL Open Collector	9 95
74188	256	TTL Open Collector	3 95
74S287	t024	Static	2 95

CSC CONTINENTAL SPECIALTIES

Proto Board 203

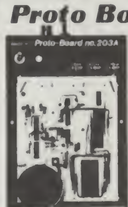


A total ready to use power breedboard prototest device with a built in regulated, short proof power supply. Just plug in and start building! 2 extra floating 5 way binding posts for external signals. Self contained with power switch indicator lamp and power fuse 24 14 pin DIP capacity. Attractive two tone quality case All metal construction. 9¼"L x 6½"W x 2¾"H 5 lbs

PB 203 **$75.00**

Model Number	L x W x H (Inches)	Price
PB-6	6.0 x 4.5 x 1.4	$15.95
PB-100	6.0 x 4.5 x 1.4	$19.95
PB-101	6.0 x 4.5 x 1 4	$22.95

Proto Board 203A



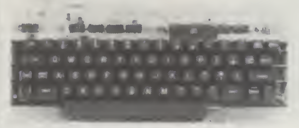
All tha features of tha PB 203 plus additional power supply fleeibility, provides 1% Reguleted 5VOC supply (same specifications es PB 203) Regulated separate +15VOC and −15 VDC 0.5A supplias, each with internally end independently adjustable output voltege. Ripple and noise of + and −15V supplies. 10mV at 0 25A

PB 203A **$124.95**

Model Number	L x W x H (Inches)	Price
PB-102	7.0 x 4.5 x 1.4	$26.95
PB-103	9.0 x 6.0 x 1.4	$44.95
PB-104	9 8 x 8.0 x 1 4	$54.95

62-Key ASCII Encoder Keyboard Kit

NEW! **JE610**



FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

The JE610 62-Key ASCII Encoder Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10mA for operation.

JE610 ..... $79.95

REGULATED POWER SUPPLY

NEW

JE200 5V-1 AMP POWER SUPPLY

- Uses LM309K
- Heat sink provided
- PC Board construction
- Provides a solid 1 amp @ 5 volts
- Can supply up to ±5V, ±9V and ±12V with JE205 Adapter
- Includes components, hardware & instructions
- Size: 3½"x5"x2"H

JE200 $14.95

JE205 ADAPTER BOARD

— Adapts to JE200 — ±5V, ±9V and ±12V

- DC/DC converter w/ +5V input
- Toriodal hi-speed switching XMFR
- Short circ. protection
- PC Brd. construction
- Piggy-back to JE200 board
- Size: 3½"x2"x9/16"h

JE205 $12.95

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance (if desired)

Spec Sheets — 25¢
1979 Catalog Available — Send 41¢ stamp

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1021 HOWARD AVENUE, SAN CARLOS, CA 94070
ADVERTISED PRICES GOOD THRU SEPTEMBER

The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable Low (normal) — 1070 space, 1270 mark, High — 025 space, 2225 mark
Receive Sensitivity	— 46 dbm accoustically coupled
Transmit Level	15 dbm nominal Adjustable from 6 dbm to 20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts.
Physical	All components mount on a single 5" by 9" printed circuit board All components included.

Requires a VDM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

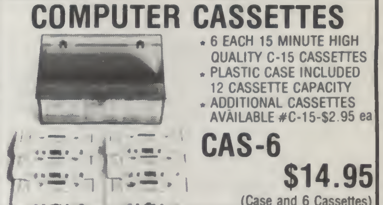
TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K. Kit comes complete with:

- 8 each UPD416-1 (16K Dynamic Rams) 250NS
- Documentation for conversion

TRS-16K $75.00

COMPUTER CASSETTES



- 6 EACH 15 MINUTE HIGH QUALITY C-15 CASSETTES
- PLASTIC CASE INCLUDED 12 CASSETTE CAPACITY
- ADDITIONAL CASSETTES AVAILABLE #C-15-$2.95 ea

CAS-6 $14.95
(Case and 6 Cassettes)

SUP 'R' MOD II

UHF Channel 33 TV Interface Unit Kit

Wide Band B/W or Color System
- Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.

MOD II is pretuned to Channel 33 (UHF).
- Includes coaxial cable and antenna transformer.

MOD II $29.95 Kit

Function Generator Kit

- Provides 3 basic waveforms: sine, triangle & square wave
- Frequency range from 1 Hz to 100K Hz
- Output amplitude from 0-volts to over 6 volts (peak to peak)
- Uses a 12V supply or a ±6V split supply
- Incl. chip, P.C. board, components and instructions

JE2206B $19.95

IDEAL FOR TRS 80 — CASSETTE CONTROLLER

"Plug/Jack interface to any computer system requiring remote control of cassette functions"

The CC100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Eliminates the plugging and unplugging of cables during computer loading operation from cassette

#CC-100 $29.50

new Micro-Miniature Joystick

- 2 each 100K pots (Linear Taper)
- Printed Circuit Board Mount
- Size: 1" x 1-3/16" x 1-3/16"

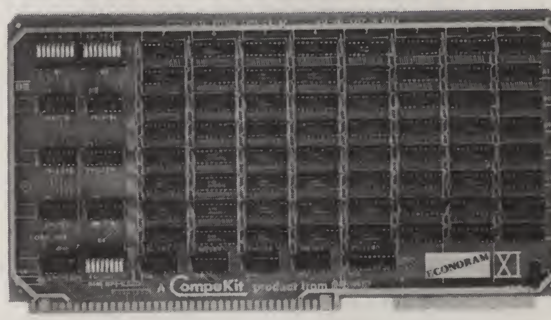
Micro-Miniature Joystick $4.95

✔ Reader Service—see page 195

GODBOUT SLASHES STATIC MEMORY PRICES AGAIN:

S-100 32K $529, 24K $398, 16K $269!

Econoram* unkits are now at their lowest prices ever. What's an "unkit"? It's a standard **Econoram** board that has all sockets and bypass caps pre-soldered in place. To complete assembly, the user simply solders in a few other parts, and inserts all ICs into their sockets. The result: A one-evening project that **saves money** while offering true **CompuPro/Econoram** quality for those on a budget. Static technology used throughout; all boards except **Econoram VI** run with 4 MHz systems. Same 1 year limited warranty, same great specs as our regular boards.



Speaking of regular boards, we offer **assembled/tested** models and boards qualified under our high-reliability **Certified System Component (CSC)** program (200 hour burn-in, immediate replacement in event of failure within 1 year of invoice date). Refer to chart below for pricing.

Name	Storage	Buss	Configuration	Unkit	Assm	CSC
Econoram IIA	8K X 8	S-100	2-4K blocks	**$149**	**$179**	**$239**
Econoram IV	16K X 8	S-100	1-16K	**$269**	**$329**	**$429**
Econoram VI	12K X 8	H8	1-8K, 1-4K	**$200**	**$270**	n/a
Econoram VIIA-16	16K X 8	S-100	2-4K, 1-8K	**$279**	**$339**	**$439**
Econoram VIIA-24	24K X 8	S-100	2-4K, 2-8K	**$398**	**$485**	**$605**
Econoram IX-16	16K X 8	Dig Grp	2-4K, 1-8K	**$319**	**$379**	n/a
Econoram IX-32	32K X 8	Dig Grp	2-4K, 1-8K, 1-16K	**$559**	**$639**	n/a
Econoram X	32K X 8	S-100	2-8K, 1-16K	**$529**	**$649**	**$789**
Econoram XI	32K X 8	SBC	2-8K, 1-16K	n/a	n/a	**$1050**
BANK SELECT MEMORIES (for Alpha Micro Systems, Marinchip, etc.)						
Econoram XII-16	16K X 8	S-100	2 ind. banks**	**$329**	**$419**	**$519**
Econoram XII-24	24K X 8	S-100	2 ind. banks**	**$429**	**$539**	**$649**
Econoram XIII	32K X 8	S-100	2 ind. banks**	**$559**	**$699**	**$849**

*Econoram is a trademark of **Bill Godbout Electronics**

**Econoram XII-16 and -24 have 2 independent banks addressable on 8K boundaries; Econoram XIII has 2 independent banks addressable on 16K boundaries.

—Did someone say extended addressing? 16 bit CPUs? All we'll say is that Econoram XIV is coming soon—

16K MEMORY EXPANSION SET — was $109, now only $87.20!

And that's for a Godbout quality product. DIP shunts included, 250 ns chips, and crystal-clear instructions make expansion a snap in **Radio Shack-80**, **Apple**, and **Exidy Sorcerer** computers. Low power chips used exclusively.

ECONORAM II CLOSEOUT—$129 unkit (3/$375), $155 assm

This is a limited quantity item — first come, first served. Our brand new **Econoram IIA** is out, but even by today's standards the original **Econoram II** is an excellent memory. 2 MHz operation, low power, configuration as two independent 4K blocks, and one of the best track records in the industry for reliable and cost-effective operation. Easy one-evening assembly, 1 year limited warranty on all components.

18 SLOT MOTHERBOARD UNKIT CLOSEOUT — was $124, now only $109

With all edge connectors pre-soldered in place for painless assembly. Includes on board active termination. **Coming soon: new 12 slot motherboard and an 18 slot double terminated model that can handle 12 MHz CPUs!**

OTHER COMPUTER PRODUCTS:

2708 EROM BOARD UNKIT $85

4 independently addressable 4K blocks, with selective disable for each block. Built to **CompuPro/Econoram** standards (dipswitch addressing, top quality board, sockets wave-soldered in place), and includes dipswitch selectable jump start built right into the board. Includes all support chips and manual, but does not include EROMs.

ACTIVE TERMINATOR KIT $34.50

As written up by Craig Anderton in the April '79 issue of **Kilobaud Microcomputing**. Our much imitated design plugs into any S-100 motherboard to reduce ringing, crosstalk, noise, and other buss-related problems.

"INTERFACER" S-100 I/O BOARD

$189 unkit, $249 assembled and tested. Dual serial port with 2 full duplex parallel ports for RS-232 handshake; EIA232C line drivers and receivers (1488, 1489) along with current loop (20 mA) and TTL signals on both ports. On board crystal controlled timebase with independently selectable Baud rate generators for each part (up to 19.2 KBaud). This board has hardware LSI UARTs that don't tie up the computer's CPU, operates with 2 to 5 MHz systems, includes software programmable UART parameters/ interrupt enables/handshaking lines, offers provision for custom frequency compensation on both receive and transmit sides to accommodate varying speed/noise situations or unusual cable lengths . . . and even all this isn't the full story on what this no-excuses board can do for you. We think this product is a real winner; check one out in person, you'll see what we mean.

TERMS: Cal res add tax. Allow 5% shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at **(415) 562-0636**. COD OK with street address for UPS. Prices good through cover month of magazine.

CompuPro™ from GODBOUT ELECTRONICS

Box 2355, Oakland Airport, CA 94614

G42

FREE FLYER: We'll be glad to tell you more than the space of this ad permits. Just send your name and address, we'll take care of the rest. If you're in a hurry, enclose 41¢ in stamps for 1st class delivery.

✓ Reader Service—see page 195

Visit our new retail location!

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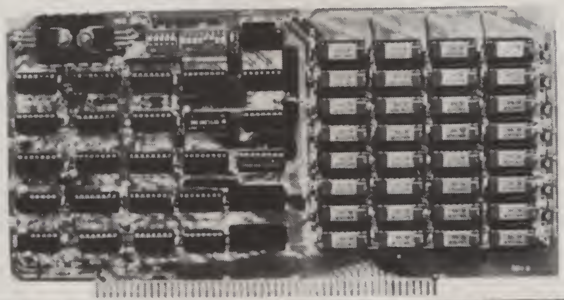
SD EXPANDORAM

The Ultimate S-100 Memory



The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

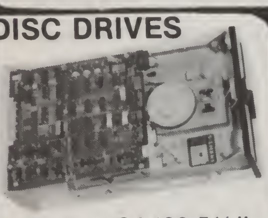
- Interfaces with Altair, IMSAI, SOL-8, Cromenco, SBC-100, and others.
- Bank Selectable
- Phantom
- Power 8VDC, ± 16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.

- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's.

EXPANDO 64 KIT (4116)

16K $249
32K $324
48K $399
64K $474

DISC DRIVES



Sugart SA400 5¼"
with attractive metal case
$ 325

Sugart 801
with attractive metal case
$495.00

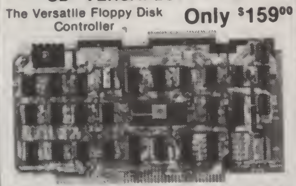
Siemens FDD 200-8 8" double-sided double density

$650.00

DISC CONTROLLER

SD "VERSAFLOPPY" Kit

The Versatile Floppy Disk Controller — Only $159[00]



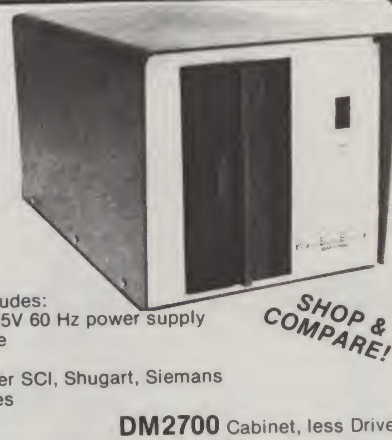
FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:
1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy.
3. PERSCI 70 and 277.
4. MFE 700/750.
5. CDC 9404/9406.
6. GSI/Siemans FDD120-8.

34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Comptler. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives, Both Mini and Full Size. FD1771B-1 Single Density Controller Chip. Listings for Control Software are included in price.

CPM for SD Versafloppy $100[00]

SAVE $100[00]

DM2700S DISK & CABINET with POWER SUPPLY



DM2700S includes Siemans or Shugart Disk Drive with the following features:

- Single or Double Density
- Hard or Soft Sector
- Write Protect
- Hard Sector Detection
- 500 KB/S Transfer
- 800 KB unformated
- Bit density 6536 BP1
- Sugart 800 Series Compatable

Cabinet includes:
- 110V to 125V 60 Hz power supply
- Data Cable
- Fan
- Accepts per SCI, Shugart, Siemans 8" Drives

SHOP & COMPARE!

DM2700S Disk Drive & Cabinet
REG. $750 SALE PRICED $650[00]

DM2700 Cabinet, less Drive ~~$249[00]~~ $225[00]

SPECIAL: SD Versafloppy Kit, CPM, and DM2700S $888

CONTINENTAL SPECIALTIES CORPORATION

CSC Logic Probes and Digital Pulsers

SALE SALE

LOGIC PROBES

CSC logic probes are the ultimate tool for breadboard design and testing These hand-held units provide an instant overview of circuit conditions. Simple to use; just clip power leads to circuit's power supply, set logic family switch to TTL/DTL or CMOS/HTL. Touch probe to test node. Trace logic levels and pulses through digital circuits. Even stretch and latch for easy pulse detection. Instant recognition of high, low or invalid levels, open circuits and nodes. Simple, dual-level detector LEDs tell it quickly, correctly. HI (Logic "1"); LO (Logic "0"). Also incorporates blinking pulse detector. e.g., HI and LO LEDs blink on or off, tracking "1" or "0" states at square wave frequencies up to 1.5 MHz. Pulse LED blinks on for ⅓ second during pulse transition. Choice of three models to meet individual requirements; budget, project and speed of logic circuits.

MODEL LP-1

Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL or CMOS. **Input Impedance:** 100,000 ohms. **Minimum Detectable Pulse:** 50 ns. **Maximum Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.

CSC Model LP-1 Logic Probe—Net Each .... ~~$44.95~~ $42.70

MODEL LP-2

Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. **Input Impedance:** 300,000 ohms. **Minimum Detectable Pulse:** 300 ns. **Maximum Input Signal (Frequency):** 1.5 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** None.

CSC Model LP-2 Logic Probe—Net Each .... ~~$24.95~~ $23.70

MODEL LP-3

High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 ohms. **Minimum Detectable Pulse:** 10 ns. **Maximum Input Signal (Frequency):** 50 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.

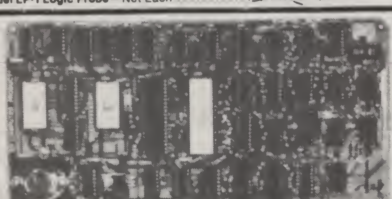
CSC Model LP-3 Logic Probe—Net Each .... ~~$69.95~~ $66.45

DIGITAL PULSER

The ultimate in speed and ease of operation. Simply connect clip leads to positive and negative power, then touch DP-1's probe to a circuit node; automatic polarity sensor detects circuit's high or low condition. Depress the pushbutton and trigger an opposite polarity pulse into the circuit. Fast troubleshooting includes injecting signals at key points in TTL, DTL, CMOS or other popular circuits. Test with single pulse or 100 pulses per second via built-in dual control push-button; button selects single shot or continuous modes. LED indicator monitors operating modes by flashing once for single pulse or continuously for a pulse train. Completely automatic, pencil-size lab/field pulse generator for any family of digital circuits. **Output:** Tri-state. **Polarity:** Pulse-sensing auto-polarity. **Sync and Source:** 100 mA. **Pulse Train:** 100 pps. **LED Indicator:** Flashes for single pulse; stays lit for pulse train.

CSC Model DP-1 Digital Pulser—Net Each .... ~~$74.95~~ $71.20

SD COMPUTER BOARDS

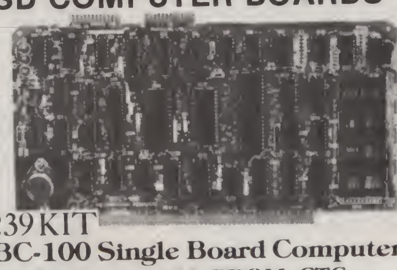


$319 KIT

VDB-8024 Video Display Board

With On-Board Z80 Microprocessor

- Full 80 Characters by 24 lines display
- Characters displayed by High Resolution 7×10 Matrix
- Keyboard Power and Interface
- Composite Video Output
- Separate TTL Level Synchronization and Video Outputs
- 2K Bytes Independent On Board Memory
- On-Board Z80 Microprocessor
- Glich Free Display
- 96 Upper and Lower Case Characters
- 32 Special Character Set
- 128 Additional user Programmable Characters
- Full Cursor Control
- Forward and Reverse Scrolling Capability
- Operates as an Independent Terminal
- Variable Speed Display Rate
- Blinking, Underlining, Field Reverse, Field Protect and Combinations

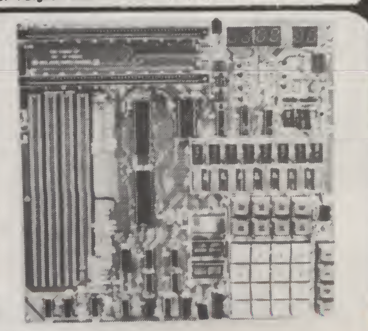


$239 KIT

SBC-100 Single Board Computer

with On-board RAM, PROM, CTC

- Four Channel Counter/Timer (Z80-CTC)
- Software Programmable Baud Rate Generator
- S-100 Bus Compatible
- No Front Panel Required for Operation
- Optional Vectored Interrupts
- Z80Central Processing Unit
- 1024 Bytes of Random Access Memory
- 8K Bytes of Available PROM
- Serial Input/Output Port with both Synchronous and Asynchronous Operation
- Parallel Input and Output Ports



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Z80 Starter Kit

A Complete Microcomputer on a Board

- Z80 Central Processing Unit with 158 Instructions
- On Board Keyboard and Display
- Kansas City Standard Cassette Interface
- PROM Programmer Built on-board
- Expansion provision for two S-100 Connectors
- Wire Wrap area for custom circuitry
- Single 5 Volt Operation when not programming
- 1K Bytes of RAM (Expandable to 2K Bytes)
- 1K Bytes of RAM (Expandable to 2K Bytes)
- 4 Channel Hardware Counter/Timer (Z80-CTC)
- Two Bi-directional 8-bit I/O Ports (Z80-PIO)
- Switch Selectable PROM or Monitor Restart
- 2K Byte ZBUG Monitor in ROM
- Memory Examine and Change
- Port Examine and Change
- Z80 CPU Register Examine and Change
- Up to 5 Programmable Breakpoints
- Single Step through RAM or PROM
- Audio Cassette Load and Dump
- Vectored Interrupts provided by Z80-CTC and Z80-PIO
- Ideal for Experimentation and Evaluating the Z80 CPU

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- **VP-10** X10 DCV Probe Adapter/ Protector 10Kv $14.95
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RS232 & "D" TYPE CONNECTORS

P = Plug Male S = Socket-Female C = Cover-Hood

PART NO.	DESCRIPTION	PRICE 1-4	5-9	10-24
DE-9P	9 Pin Male	1 50	1 30	1 10
DE-9S	9 Pin Female	1 95	1 75	1 45
DE-9C	9 Pin Cover	1 50	1 30	1 10
DA15P	15 Pin Male	2 00	1 80	1 55
DA15S	15 Pin Female	2 90	2 70	2 45
DA15C	15 Pin Cover	1 80	1 60	1 30
DB-25P	**25 Pin Male**	**2.50**	**2.20**	**2.05**
DB-25S	**25 Pin Female**	**3.50**	**3.10**	**2.95**
DB51212-1	**1 pc. Grey Hood**	**1.65**	**1.35**	**1.20**
DB1226-1A	**2 pc. Black Hood**	**1.80**	**1.50**	**1.35**
DB110963-3	**2 pc. Grey Hood**	**1.70**	**1.40**	**1.25**
DC37P	37 Pin Male	3 95	3 75	3 50
DC37S	37 Pin Female	5 50	5 25	4 90
DC37C	37 Pin Cover	2 00	1 80	1 60
DD50P	50 Pin Male	5 00	4 75	4 60
DD50S	50 Pin Female	6 50	6 00	5 75
DD50C	50 Pin Cover	2 50	2 30	2 20
D20418-S	Hardware Set (2 pair)	1 00	80	70

MALE / FEMALE

Connector for CENTRONICS 700 SERIES:
Amphenol 57-30360 for back of Centronics 700 Series printers
1-4 — $9 00 5-up — $7 50

SALE S-100 BUS EDGE CONNECTORS SALE

S100-WWG 50/100 Cont 125 ctrs 3 LEVEL WIRE WRAP .025 sq posts on .250 spaced rows GOLD PLATED
1-4 $4.00 | 5-9 $3.75 | 10-24 $3.50

S100-STG 50/100 Cont 125 ctrs DIP SOLDER TAIL on 250 spaced rows for VECTOR, IMSAI, CROMENCO motherboards GOLD plated
1-4 $3.50 | 5-9 $3.25 | 10-24 $3.00

S100ALT 50/100 Cont 125 ctrs DIP SOLDER TAIL on 140 spaced rows for ALTAIR motherboards. GOLD plated
1-4 $4.50 | 5-9 $4.25 | 10-24 $4.00

S100SE 50/100 Cont 125 ctrs PIERCED SOLDER EYELET tails GOLD
1-4 $5.00 | 5-9 $4.50 | 10-24 $4.00

Other Popular Edge Connectors

D2244-5SE 22/44Cont 156 ctrs PIERCED SOLDER EYELET tails GOLD plated
1-4 $3.00 | 5-9 $2.60 | 10-24 $2.20

D2244-5WW 22/44 Cont 156 ctrs WIRE WRAP tails. GOLD
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CG-1 IMSAI Style Card Guides 5/$1 00

See our July Ad for many other connectors.

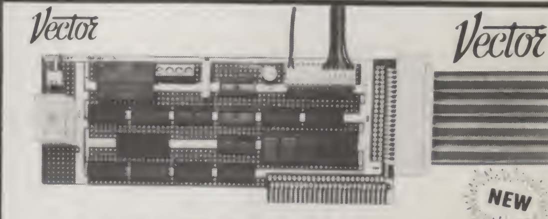
3 LEVEL GOLD WIRE WRAP SOCKETS

Sockets purchased in multiples of 50 per type may be combined for best price.

	1-9	10-24	25-99	100-249	250-999
8 pin	.40	.36	.34	.31	.27
14 pin	.39	.38	.36	.32	.31
16 pin	.50	.42	.40	.36	.34
18 pin	.70	.60	.55	.50	.45
20 pin	.90	.80	.75	.65	.62
22 pin	.95	.85	.80	.70	.65
24 pin	.95	.85	.80	.70	.65
28 pin	1.25	1.15	1.00	.95	.90
40 pin	1.65	1.45	1.35	1.20	1.10

All sockets are GOLD 3 level closed entry. 2 level Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION.

Vector APPLE PLUGBOARD



NEW

Vector 4609 Peripheral Interface Plugboard for construction of custom circuits. Plug compatible with Apple II, Commodore PET and Super Kim microcomputers. Three connectors, in addition to the standard 25/50 system bus, are available for input/output. A 20/40-contact card-edge connector, fabricated on the rear of the board, mates with a 3-M type ribbon connector. Alternatively, a right-angle solder-tail header may be positioned in this same location. The Model 4609 also accomodates the miniature SIP-type connectors which may be placed on the periphery or in mid-board.

1-4	5-9	10-24
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8803 Vector MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

- Kit includes 12 tantalum capacitors for +5 +12, −12 buses and insulated mounting spacers
- Wiring side shown. Component side bare epoxy glass with white markings for component locations
- G10 epoxy glass board with 2 ounce copper solder plated and 038 diameter holes for leads
- Solder mask with solder windows on etched circuits to avoid accidental short circuits
- Mounts 11 receptacles with 100 contacts (2 rows) on 125 centers with 250 row spacing. Vector part number R681-2 or mounts 10 receptacles plus interconnections to smaller mother board for expansion
- Includes etched circuits and instructions for option of active pull-up or floating terminations
- Large buses +5V and GND (10 AMPS). ± 12V or 16V (7 AMPS) Current ratings are per MIL STD-275 with 10°C rise
- Fits in Vector-pak enclosures
- Fits in IMSAI 8080 microcomputer as expander board

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Vector Plugboards

8800V
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware 5 3" x 10 x 1/16

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$19.95	$17.95	$15.96

8801-1
Same as 8800V except plain, less power buses & heat sink

1-4	5-9	10-24
$15.22	$13.79	$12.18

3682 9.6" x 4.5" **$10.97**
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3677 9 6" x 4.5' **$10.90**
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Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

3662 6.5" x 4.5" **$7.65**
3662-2 9.6" x 4.5" **$11.45**
P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced 156

3690-12
CARD EXTENDER
Card Extender has 100 contacts 50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems. **$25.83**
3690 6.5" 22/44 pin .156 ctrs. Extenders $13.17

1/16 Vector BOARD
.042 dia holes on 0.1 spacing for IC's

	PART NO.	SIZE	PRICE 1-9	10-19
Phenolic				
	64P44XXXP	4.5x6.5"	$1.56	$1.40
	169P44XXXP	4.5x17"	$3.69	$3.32
Epoxy Glass				
	64P44	4.5x6.5"	$1.79	$1.61
	84P44	4.5x8.5"	$2.21	$1.99
	169P44	4.5x17"	$4.52	$4.07
	169P84	8.5x17"	$8.03	$7.23

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QTY.			
1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zenner	.25
1N4749	24v	1W	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25
1N5349	12v	3W	.25

SOCKETS/BRIDGES

QTY.					
8-pin	pcb	.16	ww	.35	
14-pin	pcb	.20	ww	.40	
16-pin	pcb	.25	ww	.45	
18-pin	pcb	.30	ww	.95	
20-pin	pcb	.35	ww	1.05	
22-pin	pcb	.40	ww	1.15	
24-pin	pcb	.45	ww	1.25	
28-pin	pcb	.50	ww	1.35	
40-pin	pcb	.55	ww	1.45	
Molex pins	.01	To-3 Sockets		.35	
2 Amp Bridge		100-prv		.95	
25 Amp Bridge		200-prv		1.50	

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QTY.		
2N2222M	(2N2222 Plastic .10)	.15
2N2222A		.19
2N2907A	PNP	.19
2N3906	PNP (Plastic)	.19
2N3904	NPN (Plastic)	.19
2N3054	NPN	.55
2N3055	NPN 15A 60v	.60
T1P125	PNP Darlington	1.95
LED Green, Red, Clear, Yellow		.19
D.L.747	7 seg 5/8" High com-anode	1.95
MAN72	7 seg com-anode (Red)	1.25
MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74	7 seg com-cathode (Red)	1.50
FND359	7 seg com-cathode (Red)	1.25

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9301	.85	9322	.65
9309	.50	9601	.30
		9602	.45

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8T13	2.50
8T23	2.50
8T24	3.00
8T97	1.75
74S188	3.00
1488	1.25
1489	1.25
1702A	4.50
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MM 5316	4.50
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MM 5369	2.95
TR 1602B	3.95
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Z 80	17.50
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8216	3.50
8224	4.25
8228	6.00
8251	7.50
8253	18.50
8255	8.50
TMS 4044	9.95

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QTY.		QTY.		QTY.		QTY.	
7400	.20	7492	.45	74H20	.25	74LS76	.70
7401	.20	7493	.35	74H21	.25	74LS86	.95
7402	.20	7494	.75	74H22	.40	74LS90	.85
7403	.20	7495	.60	74H30	.30	74LS93	.85
7404	.20	7496	.80	74H40	.35	74LS96	2.00
7405	.35	74100	1.15	74H50	.30	74LS107	.90
7406	.25	74107	.35	74H51	.30	74LS109	1.50
7407	.55	74121	.35	74H52	.20	74LS123	1.95
7408	.20	74122	.55	74H53	.25	74LS138	2.00
7409	.25	74123	.55	74H55	.25	74LS151	.95
7410	.20	74125	.45	74H72	.35	74LS153	1.15
7411	.25	74126	.45	74H74	.35	74LS157	1.15
7412	.25	74132	.75	74H101	.95	74LS160	1.15
7413	.45	74141	.90	74H103	.55	74LS164	2.90
7414	.75	74150	.85	74H106	1.15	74LS193	2.00
7416	.25	74151	.95	74L00	.30	74LS195	1.15
7417	.40	74153	.95	74L02	.30	74LS244	2.90
7420	.25	74154	1.15	74L03	.35	74LS259	1.50
7426	.25	74156	.70	74L04	.40	74LS298	1.50
7427	.25	74157	.65	74L10	.30	74LS367	1.95
7430	.20	74161/9316	.75	74L20	.45	74LS368	1.25
7432	.30	74163	.85	74L30	.55	74LS373	2.50
7437	.20	74164	.75	74L47	1.95	74S00	.45
7438	.30	74165	1.10	74L51	.65	74S02	.45
7440	.20	74166	1.75	74L55	.85	74S03	.35
7441	1.15	74175	.90	74L72	.65	74S04	.35
7442	.55	74176	.95	74L73	.70	74S05	.45
7443	.45	74177	1.10	74L74	.75	74S08	.45
7444	.45	74180	.95	74L75	1.05	74S10	.45
7445	.75	74181	2.25	74L85	2.00	74S11	.45
7446	.70	74182	.75	74L93	.75	74S20	.35
7447	.70	74190	1.25	74L123	1.95	74S22	.55
7448	.50	74181	2.25	74LS00	.40	74S40	.30
7450	.25	74182	.75	74LS01	.40	74S50	.30
7451	.25	74193	.85	74LS02	.45	74S51	.35
7453	.20	74194	.95	74LS03	.45	74S64	.15
7454	.25	74195	.95	74LS04	.45	74S74	.70
7460	.40	74196	.95	74LS05	.45	74S112	.60
7470	.45	74197	.95	74LS08	.45	74S114	.85
7472	.40	74198	1.45	74LS09	.45	74S133	.85
7473	.25	74221	1.50	74LS10	.45	74S140	.75
7474	.30	74298	1.50	74LS11	.45	74S151	.95
7475	.35	74367	1.35	74LS20	.45	74S153	.95
7476	.40	75491	.65	74LS21	.45	74S157	.98
7480	.75	75492	.65	74LS22	.45	74S158	.80
7481	.85	74H00	.20	74LS32	.50	74S194	1.50
7482	.95	74H01	.30	74LS37	.45	74S196	2.00
7483	.95	74H04	.30	74LS38	.65	74S257 (8123)	2.50
7485	.75	74H05	.25	74LS40	.70	8131	2.75
7486	.55	74H08	.35	74LS42	.95		
7489	1.05	74H10	.35	74LS51	.75		
7490	.55	74H11	.25	74LS74	.95		
7491	.70	74H15	.45	74LS75	1.20		

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QTY.		QTY.		QTY.		QTY.	
4000	.15	4017	.75	4034	2.45	4069/74C04	.45
4001	.20	4018	.75	4035	.75	4071	.25
4002	.25	4019	.35	4037	1.80	4081	.30
4004	3.95	4020	.85	4040	.75	4082	.30
4006	.95	4021	.75	4041	.69	4507	.95
4007	.25	4022	.75	4042	.65	4511	.95
4008	.75	4023	.25	4043	.50	4512	1.50
4009	.35	4024	.75	4044	.65	4515	2.95
4010	.35	4025	.25	4046	1.25	4519	.85
4011	.30	4026	1.95	4047	2.50	4522	1.10
4012	.25	4027	.35	4048	1.25	4526	.95
4013	.40	4028	.75	4049	.65	4528	1.10
4014	.75	4029	1.15	4050	.45	4529	.95
4015	.75	4030	.30	4052	.75	MC14409	14.50
4016	.35	4033	1.50	4053	.95	MC14419	4.85
				4066	.75	74C151	2.50

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MCT2	.95	LM320K24	1.65	LM373	3.95
8038	3.95	LM320T5	1.65	LM377	3.95
LM201	.75	LM320T12	1.65	78L05	.75
LM301	.45	LM320T15	1.65	78L12	.75
LM308	.65	LM323K	5.95	78L15	.75
LM309H	.85	LM324	1.25	78M05	.75
LM309 (340K-5)	1.50	LM339	.75	LM380 (8-14 Pin)	1.19
LM310	.85	7805 (340T5)	1.15	LM709 (8-14 Pin)	.45
LM311 (8-14 Pin)	.75	LM340T12	.95	LM711	.45
LM318	1.50	LM340T15	.95	LM723	.40
LM320H6	.79	LM340T18	.95	LM725	2.50
LM320H15	.79	LM340T24	.95	LM739	1.50
LM320H24	.79	LM340K12	1.25	LM741 (8-14)	.45
7905 (LM320K5)	1.65	LM340K15	1.25	LM747	1.10
LM320K12	1.65	LM340K18	1.25	LM1307	1.75
LM320K15	1.65	LM340K24	1.25	LM1458	.65
				LM3900	.95
				LM75451	.65
				NE555	.45
				NE556	.85
				NE565	1.15
				NE566	1.25
				NE567	.95
				TA7205	6.95
				76477	2.95
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ANOTHER MINISCOPE! NEW

FEATURES

- Dual Trace—2-channel; separate, chopped or alternate modes.
- 30-megahertz bandwidth. • External and internal trigger.
- Time Base—0.05 microseconds to 0.2 Sec./div—21 settings. • Battery of line operation.
- Line synchronization mode. • Power consumption less than 50W.
- Vertical Gain—0.01 to 50 volts/div—12 settings. Size: 2.9" H x 6.4" W x 8.5" D.
- Weighs only 3.5 lbs with batteries.
- TEST MOST DIGITAL LOGIC CIRCUITS INCLUDING MICROPROCESSORS

From the originators of the Digital Voltmeter, the people who have broken sales and performance records for Osciloscopes, Non-Linear Systems, comes the MS-230 miniscope.

Non Linear Systems took their engineering and modular construction skills and made a dream a reality, a Dual-Trace 30 MHz miniscope, small enough to fit in most briefcases with room to spare at an affordable price.

VERTICAL

Mode: *CH1, CH2, CH1 & CH2 (Chopped) & CH2 (Alt.) (The following specifications apply to each channel.)*
Bandwidth: DC to 30 MHz, ± 3 db @ 3 division deflection. Typical 4 division deflection is obtainable up to 20 MHz.
Coupling: AC, DC or ground, switch selectable. Low frequency 3 db point on AC is 3 Hz.
Rise Time: Approximately 10 nSec @ 3 division deflection.
Vertical input: 10 mV/div to 50V/div in 12 calibrated ranges. Accuracy is 3% of full scale with vernier in full clockwise position. Vernier provides continuously variable deflection factors between fixed ranges, uncalibrated.
Input Impedance: 1 megohm in parallel with 50 pF.
Maximum Input Voltage: 250V (DC and Peak AC).

HORIZONTAL

Mode: Internal Time Base or External Horizontal, switch selectable. In the XY mode, vertical input is through CH1 and horizontal input through CH2.
Time Base: 0.5u Sec/div to 0.2 Sec/div in 21 calibrated ranges. Accuracy is 3% of full scale with vernier in full clockwise position. Vernier provides continuously variable settings between fixed ranges, uncalibrated.
Amplifier
Bandwidth: DC to 1 MHz (± 3 db)
Coupling: AC, DC or ground, switch selectable. Low frequency point on AC is 3 Hz.
Deflection Factor: 10 mV/div to 50V/div in 12 calibrated ranges. The ranges can be calibrated with the CH2 gain control.
Input Impedance: 1 megohm in parallel with 50 pF.
Maximum Input Voltage: 250V (DC and Peak AC).

TRIGGER

Modes:
Automatic: trigger is disabled, time base free runs.
Internal: In the dual trace modes, the internal trigger source is CH1. External and Line (line not functional when MS-230 operates on batteries.) input impedance is 1 megohm on External Trigger.
External: Controls function as for internal triggering (1 Megohm input impedence)
Line: Trigger is derived from line frequency when using the battery charger
Slope: + or -, switch selectable.
Coupling: AC
Sensitivity: Less than 1 div for internal trigger and less than 1 volt for external trigger.
Level: Trigger level control permits continuous adjustment of trigger point in all modes except Auto.

CALIBRATOR:

A square-wave signal of 1 volt p-p is provided. Voltage accuracy is ±5%, frequency is approximately 1 KHz.

DISPLAY

Graticule: 4 x 5 div, each division is 0.25 inch, Viewing area 1.1" H x 1.35" W.

CRT:

Bluish-white phosphor, medium persistence. CRT uses low power filament for low battery drain.

POWER SOURCES

Internal: Three sealed, rechargeable lead-acid cells. Operating time using fully charged cells is approximately 45 minutes. Charging circuitry is integral and functions when the MS-230 is connected to power line through plug-in transformer (supplied with each instrument). Battery charge time with instrument non-operating is 16 hours.
External: Operates continuously from 115 vac source 50 - 400 Hz when connected via plug-in transformer. (230 vac is available) Power consumption from AC line is less than 50 watts.

ENVIRONMENT

Operating Temperature: 0° to 40°C
Shock and Vibration: Will withstand normal shock and vibration encountered in commercial shipping and handling.

PHYSICAL MEASUREMENTS

Size: 2.9" H x 6.4" W x 8.5" D. (73.7 mm x 162.6mm x215.9 mm)
Weight: 3.5 lbs. (1.59 kg) with batteries.

FURNISHED ACCESSORIES:

Tilt stand, battery charger, 2 input cables, and 3 miniature banana plugs

WARRANTY:

One year parts and labor. Made in the USA!

MS-230 with Rechargeabie Batteries and Charger

$559.00

PROBES

Deluxe 10 to 1 probe with 10 megohm input. 100 MHz probe with 4 interchangeable tips: Spring-loaded retractable cover tip, Insulating tip, BNC tip, IC tip, also included cap adjustment tool and zippered vinyl case.

41-141 .... **$27.00**

DELUXE COMBINATION PROBE

Same as above except the probe has a switch to select; 10 to 1, 1 to 1 or a ground reference position.
41-37R Red probe body
41-37G Grey probe body **$38.50**

LEATHER CARRYING CASE

The leather case has 2 separate compartments One to hold the scope, the other to hold the charger, probe, shoulder strap, etc The case can be worn on the belt, or over the neck

The snaps used on the case are "one way", thus accidental striking of the case against an object will not undo the snaps or let it be pulled off your belt

41-180 .... $45.00

75.00 OFF

on any accessories purchased with MS-230 Miniscope. Just send or mention this COUPON and Kilobaud Magazine.

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P21

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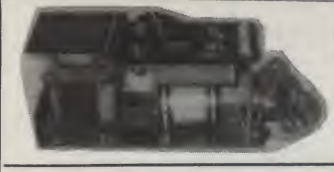


POWER SUPPLIES REGULATED COMPUTER

Ideal for micro and mini computers. These units have been removed from equipment, checked out and guaranteed. 5 volts @ 8 amps + 12 volts. 2 amps + 6 volts @ 75 MA. Power supply has a 3-wire line cord and fused. Dimensions: 10½"x5½"x4½". Shipping weight: 16 lbs.

37.50
2 FOR 70.00

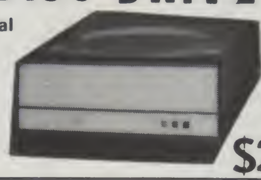
WIRE WRAP BOARDS

These boards are pre-wired and removed from equipment. Easy to unwrap for setting up your own board, contains mostly 14-pin IC sockets with individual pin connections. Each board has VCC and ground planes.

Reduced prices

Smaller board measures 6½"x6" and has 40 to 50 sockets. ~~Price $11.00 ea. 2/$20.00~~ $7.50 ea.2/$14.00
Larger board measures 13½"x6" and has 75 to 100 sockets. ~~Price $17.50 ea. 2/$33.00~~ $12.50 ea.2/$23.00

DIABLO SYSTEM DISC DRIVE

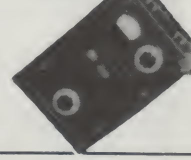


SERIES 40 MODEL 43 100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM: 2400, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.

$2495

FM SIGNAL GENERATOR

MEASUREMENTS MODEL 560 FM



Frequency 25 mhz to 80 mhz and 130-175 mhz. Dimensions: 10"x10"x16", weight: 16 lbs. Shipped freight collect. Used. Checked out and operating.

$289

TRANSFORMERS ISOLATION STEP-DOWN TYPE

Primary: 230/115V, 50/60 CPS, Secondary: VA output 250V. **$13.95** EACH

I.C.'s

7444	.45	74H72J	.45
7450	.23	74H72N	.30
7453	.23	74H73N	.40
7460	.23	74H76N	.45
7470	.25	74H87N	1.30
7482	.50	74H101J	.65
7490	.35	74H103J	.50
7491	.65	74H108J	.50
74104	.30	74H50	.23
74111	.35	74H40	.23
74121	.30	74H51	.23
74122	.45	74H21	.23
74142	.90	74H30	.23
74145	.45	74SO9	.23
74156	.35	74S134	.25
74180	.45	74S135	.45
74198	1.45	75150	.85
74249	.45	75154	1.25
74265	.35	LM101H	.75
74HO5N	.25	LM318H	1.25
74H15N	.40	NE531T	.80
74H22J	.30	NE565A	.75
74H60N	.23	LM556CN	.75
74H61J	.30	74H61N	.23
74H71N	.30	CA324G	.50
RC741DP	.18	RC747DP	.30

MEMORY PHONES

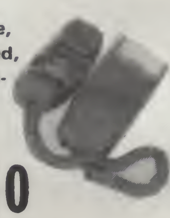
By FORD INDUSTRIES, INC.

These units have complete installation and operating instructions w/6-foot cord. Colors: beige, white, green, Used, operating condition.

$89

TRENDLINE PHONES

Mfd. by I.T.T.



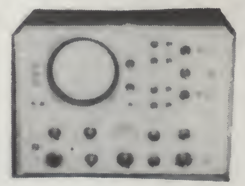
Rotary dial. Colors: white, black, red, green. Packaged, has 6-foot cord and installation instructions. Used, operating condition.

34.50

HEWLETT-PACKARD
Model 175A

OSCILLOSCOPES

These scopes have a 50 Mhz bandwidth and have 2 plug-ins, a 1781B Delay generator and a model 1755A Dual trace vertical amplifier. Dimensions: 13"x17"x25", weight 71 lbs. shipped freight collect. 5" scope. Used. Checked out and operating.



$339

ROTRON WHISPER FANS

Unused, Model Rotron MU 3A1, 230V, AC, 14 watts, 50/60 hz, guaranteed, 4½"x4½"x1½".

$8.95

CRYSTAL OSCILLATORS

Vectron type CO-231T crystal freq. 4.9152, MHZ w/tuning option for accuracy of .0001%. 1½"x 1½"x½".R.F.E.

13.95

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Readouts assembled of the 710 series modules. Character 1" high w/lamps. Type No. 344. By Dialco.

1.50 EACH

I.C. SOCKETS

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IO4 2 Parallel & 2 Serial I/O Board

Two serial ports, two parallel inputs, and two parallel outputs, plus an optional 134.5 BAUD for the serial interface to run most Selectrics make this an extremely popular interface board.

Capable of supporting EIA (RS232) and current loop interface devices. The current loop can be optically isolated from the power supply of the mainframe.

The serial interfaces have BAUD rates from 55 BAUD to 9600 BAUD. Word length, parity even and odd, and number of stop bits are DIP switch selectable.

Specifications

Number of ports
- Two serial ports with status
- Two parallel inputs
- Two parallel outputs

Serial interface
- Current loop by optical isolators
- 20/60 ma current-loop
- EIA receivers and drivers
- 55 to 9600 baud
- 134.5 baud (optional for running selectrics
- UART presets by dip switch:
  - —stop bits
  - —word length
  - —parity even and odd
- +5V, +12V & -12V available at connector

Parallel interface
- Latch type—8212
- +5V & -12V available at connector

Addressing
- Dip switch addressing of serial I/O to any four port boundary
- Dip switch addressing of parallel I/O to any two port boundary

Number of IC's
- 37 IC's

PC board
- Solder masked

Power requirements
- +8V at 0.95A typical
- +16V at 0.6 A typical
- -16V at 80 ma typical

1411	IO4 kit	$139
1412	IO4 a&t	$185
1413	IO4 bb	$ 26

SB1 Music Synthesizer Board

Enables the user to encode and play back complex musical arrangements. The user can define the attack and sustain, duration, pitch, tempo, volume level, wave form, envelope shape, and more. The necessary software is included.

The software control is so flexible and sophisticated that the SB1 is well beyond the capabilities of competing microcomputer synthesizers. Want five-part harmonies? The software will drive up to eight boards, for the most complex of harmonies.

Specifications

Addressing
- Memory map, 256 bytes
- Any 256 byte boundary from 8000 Hex

Frequency range
- 15Hz to 25Hz
- error maximum

Volume range
- 16 linear steps

Waveform definition
- 32 bytes long
- 256 levels high

Envelope definition
- 16 bytes long
- 16 levels high
- Duration 4 sec to 0.05 sec

Software support
- Music interpreter—MUS-X1
- Nine octave control
- Can run 8 SB1 cards together (harmony)
- Note duration—double whole note to 1/64 note
- Triplets, repeats, ties
- Tempo—40 beats per minute to 200 beats per minute—2/2 to 8/8 time
- Software on paper tape in Intel Hex check-sum format

Buffering
- All lines buffered

Number of IC's
- 45 Ic's

Power requirements
- +8V at 1.1A typical
- +16V at 20 ma typical
- -16V at 20 ma typical

1408	SB1 kit	$150
1409	SB1 a&t	$212
1410	SB1 bb	$ 35
1444	SB-1 Software	$ 25

OB1 Vector Jump & Prototyping Board

Implement vector jump for a computer without a front panel. Activated by power-on or reset, the OB1 will vector jump to any memory location. A prototyping area is provided.

Specifications

Prototyping areas
- 3 x 24/28 pin patterns
- 10 x 16 pin patterns
- 2 spare regulator patterns

Number of IC's
- 7 IC's

Power requirements
- +8V at 150 ma typical

Vector jump
- Range—65536 bytes
- 1 byte increments
- Dip switch selection
- Jump with power-on/reset
- Will work with systems not equipped with phantom disable

1429	OB1 kit	$ 45
1430	OB1 a&t	$ 74
1431	OB1 bb	$ 26

MB8A 1K/16K EPROM Board

The MB8A provides sockets to support up to 16 2708 EPROMs—the most widely used EPROM in the microcomputer industry. The board disables in 1K increments simply by removing the 1K EPROMs.

The MB8A's Magic Mapping enables the user to overlay RAM and ROM at the same address in any desired increment when used with RAM boards equipped with Phantom Disable.

With the MB8A board, you can permanently store two or three large programs such as BASIC.

Specifications

Memory capacity
- 16384 bytes

Memory type
- 2708 EPROM (not included)
- 1024 x 8 bits

Addressing
- Any 16K boundary
- Dip switch selection
- RAM/ROM overlay capability (Magic Mapping)
- Disable in 1K increments

Wait states
- 0 to 8 clock cycles

Additional circuitry
- Power-on/reset vector jump to any 256 byte increment
- Vector jump can be disabled

Buffering
- All lines buffered

Number of IC's
- 15 IC's (less EPROMs)

Power requirements
- +8V at 160 ma typical (less EPROMs)
- +16V at 10 ma typical (less EPROMs)
- -16V at 10 ma typical (less EPROMs)

1433	MB8A kit	$ 78
1434	MB8A a&t	$125
1435	MB8A bb	$ 26

2K Monitor Chips

Software monitor program for 8080 systems. The firmware provided in the eight 1702 or two 2708 EPROMs will allow the user to perform the following:

1175	2708 Video	$45
1176	1702 Video	$45
1314	2708 Teletype	$45

- Set bytes of memory:
- Move blocks of data in memory
- Read or dump to I/O devices in Intel checksum format, or in binary format
- Display the registers of the 8080
- Go to the beginning of a program and set optional breakpoints
- Do simple Hex math
- Fill areas of memory with a specific byte
- Change console or I/O devices by software commands

PB1 2708/2716 Programmer & 4K/8K EPROM Board

Will program 2708 or 5v 2716 EPROMs. Designed to meet all manufacturers' data sheet requirements for the programming of these EPROMs.

Supporting software will transfer memory data from any location to the EPROM being programmed, and verify bit for bit the accuracy of transfer. Space is provided for optional Zero Insertion Pressure sockets from Textool.

And there is 4K of 2708 or 8K or 2716 EPROM on board (EPROMs not included). Memory is independently addressable to any 4K (2708) or 8K (2706) boundary. A disable circuit will disable unused EPROM sockets.

Specifications

Memory Capacity
- 4096/8192 bytes (four sockets)

Memory Type
- 2708 EPROM (not included)
- 2716 EPROM +5V type (not included)

Addressing:
- EPROM programmer
- Any 4K boundary
- Dip switch selection
- Separate 2708 and 2716 sockets

ON-board EPROMs
- Any 4K/8K boundary above 8000 Hex
- Dip switch selection
- Unused sockets do not enable data bus drive

Wait states
- 0 to 4 clock cycles

Buffering
- All lines buffered

Special feature
- LED indicator for programming mode
- Switch to turn-off programming voltage prevents accidental ROM programming
- Optional Textool sockets (for programming only)

Number of IC's
- 22 IC's (less EPROMs)

Software
- Programming software & bit for bit verify routines provided

PC Board
- Solder masked

1440	PB1 kit w/textool	$125

IO2 Parallel I/O Board

An inexpensive I/O board, with one parallel input port and one parallel output port.

There is also a prototyping area. Schematics are provided which enable the user to dedicate the prototyping area as a serial interface , as a small ROM board, or as two additional parallel ports.

Specifications

Number of ports
- One 8 bit parallel input
- One 8 bit parallel output

Addressing
- 256 possible port addresses
- Dip switch & jumper selected

Prototyping areas
- 1 x 40 pin pattern
- 2 x 24 pin patterns
- 9 x 16 pin patterns
- 1 x 14 pin pattern
- 1 spare regulator pattern

Number of IC's
- 9 IC's

Power requirements
- +8V at 300 ma typical

1414	IO2 kit	$ 48
1415	IO2 a&t	$ 75
1416	IO2 bb	$ 26

XB1 Extender Board

Raises boards above the computer main frame for easy access. With optional edge connector, the XB1 is no higher than standard S-100 boards.

1427	XB1	$ 10
1428	Connector for XB1	$ 4

CB1 8080 CPU Board

256 bytes of scratchpad. RAM on board. Provisions for 2K of on-board 2708 EPROMs addressable at any 2K boundary.)

There is an 8 bit parallel input port, for keyboard, or up to 8 sensing lines for home or industrial control applications.

Optional power-on jump to on-board ROM eliminates the need for a front panel. And the board can generate an MWRITE signal.

With a video board or I/O board, you have a small computer, but with the capability to expand into a full-fledged S-100 system.

Specifications

Processor type
- 8080A

Speed
- 2 MHz

On-board EPROM
- Type—2708 (not included)
- 2048 x 8 bits capacity
- Dip switch addressing
- Any 2K boundary
- One wait state added

On-board RAM
- Type—2112-4
- 256 x 8 bits capacity
- Dip switch addressing
- Any 256 byte boundary
- No wait states added

On-board input ports
- 1 bit status port
- 8 bit data input port
- Any port address from 0 to 31 (decimal)
- Dip switch addressing

Vector jump
- Vector jump with power-on and/or reset
- Any 2K boundary
- Vector jump can be disabled

Additional circuitry
- Jumper selected MWRITE signal

Buffering
- All lines buffered

Number of IC's
- 40 IC's (less EPROMs)

PC Board
- Solder masked

Power requirements
- +8V at 0.95A typical (less EPROMs)
- +16V at 0.5A typical (less EPROMs)
- -16V at 25 ma typical (less EPROMs)

1403	CB-1 kit	$119
1404	CB-1 A&T	$175
1441	CB-1 Bd.	$ 30

VB1B Video Board

Software controlled and memory mapped. Memory Mapping means that locations in the 1K (1024 byte) on-board RAM memory correspond with locations in the 64 x 16 (1024) character display.

The 1K memory can be addressed at any 1K increment via DIP switch

The VB1B features a 128 x 48 matrix for graphics upper and lower case, Greek letters, and black on white or white on black. Software includes a driver routine for cursor control, scroll-up, and X-Y graphic control.

Specifications

Display
- 64 or 32 character per line
- 16 lines
- Graphics (128 x 48 matrix)
- Upper case, lower case & Greek characters
- Black-on-white, and white-on-black
- 8% horizontal margins
- 6% upper vertical margins

Timing
- Vertical rate—60HZ
- Horizonal Rate — 16.200Hz
- CRYstal—12 44MHz

Interface
- Composite video 75 ohm
- Separate video, horizontal & vertical sync
- Memory mapped board

On-board memory
- 1024 bytes
- 2102AL-2 (250 nsec)
- Dip switch addressing in 1K increments

Buffering
- All lines buffered

Number of IC's
- 42 IC's

Software
- Driver routine for cursor control, scroll up, etc.
- Driver routine for X-Y graphic control

Power requirements
- +8V at 1.4A typical
- +12V at 30 ma typical
- -12V at 15 ma typical

1417	VB1B kit	$129
1418	VB1B a&t	$175
1419	VB1B bb	$ 26

VB2 Video Board

An I/O controlled video interface board, With a TV monitor, becomes a video terminal. No other I/O card is required for keyboard input and video display.

The VB2 cursor, linefeed, carriage return, backspace, and clear-screen are hardware controlled. The display is 64 x 16, all upper case, and is selectable for white on black, or black on white. The board features adjustable picture size and character width.

Specifications

Display
- 64 character per line by 16 lines
- Switch selected black-on-white or white-on-black display
- Upper case characters
- Underline shaped cursor
- Hardware line feed, carriage return and backspace
- Full interlace to better resolution
- U.S. TV standard frequencies
- Crystal—14 318MHz
- Adjustable horizontal margin
- Adjustable character width
- Switch selectable vertical position

Interface
- Composite video 75 ohm
- External sync inputs for slave control of VB2
- I/O mapped board
- Parallel keyboard input
- Positive or negative keyboard status
- Full duplex
- Dip switches selection of any port address
- Drive for external beep tone

Number of IC's
- 45 IC's

PC board
- Solder masked

Power requirements
- +8V at 1.1A typical
- +16V at 79 ma typical

1438	VB2 kit	$135
1439	VB2 a&t	$195
1443	VB-2 Bd.	$ 28

MT1 15 Slot Mother Board

A basic motherboard with provisions for 100 termination resistors. Available with or without connectors.

Specifications

Connector spacing
- Across-pin—0.25"
- Between pins 0.125"

Number of connector patterns
- 15 sockets

Special feature
- Provisions for 100 termination resistors

PC board
- 11-5/8" x 11"
- 0.09" thick

1432 MT-1 (Motherbd) $39

MB6B 8K/Dual 4K Static RAM Board

Dip switch addressing of independent 4K halves lets the MB6B think like two 4K boards, or one 8K board. The independent 4K addressing allows the flexibility to meet varying software memory needs.

The MB6B is fully buffered, and is 8080, 8085, and Z-80 compatible. The board can operate at 2MHz or 4MHz, and is compatible with DMA (Direct Memroy Access] controllers.

Specifications

Memory capacity
- 8192 bytes

Memory type
- 2102AL RAM
- 1024 x 1 bits

Addressing
- Any 4K boundary
- Dip switch selection
- Board can be disabled to 4k
- Phantom disable by jumper

Speed
- 2MHz or 4MHz

Wait states
- 0 to 2 clock cycles

Buffering
- All lines buffered
- Battery hack - up available

Number of IC's
- 80 IC's

PC Board
- Solder masked

Power requirements
- +8V at 2 0A typical

1401A	MB6B a&t 450 N.S.	$183
1402	MB6B bb	$ 26
1400A	MB6B kit 450 N.S.	$139
1400B	MB6B Kit 250 N.S.	$149
1401B	MB6B A&T 250 N.S.	$196

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Winner of all tournaments! 6 levels of play, excellent graphics.
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Tarot
Excellent graphics, frighteningly accurate!
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Cat No. 1042 $5.95

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TRS-80 L1/L2 4K
Cat No. 1186 $14.95

Microchess
Graphic Chessboard with 3 levels of play.
TRS-80 L1/L2, 4K
Cat No. 1182 $19.95
Apple II
Cat No. 1183 $19.95

Daily Biorhythm
Plots a 31 day graph centered on the day you compute.
TRS-80 L1/2
Cat No. 1051 $5.95

Fortran Plus
By Microsoft! For TRS-80 L2 with 32K and single disk.
Cat No. 1341 $340

Beat the House
4 Casino games: Blackjack, roulette, craps, slot machine. Excellent simulation.
TRS-80 L2, 16K
Cat No. 1347 $14.95
Apple II, 16K
Cat No. 1349 $14.95

Level III Basic
Gives your TRS-80 the power of a full size system. Disk commands, advanced editing, etc.
TRS-80 L2, 16K
Cat No. 1332 $49

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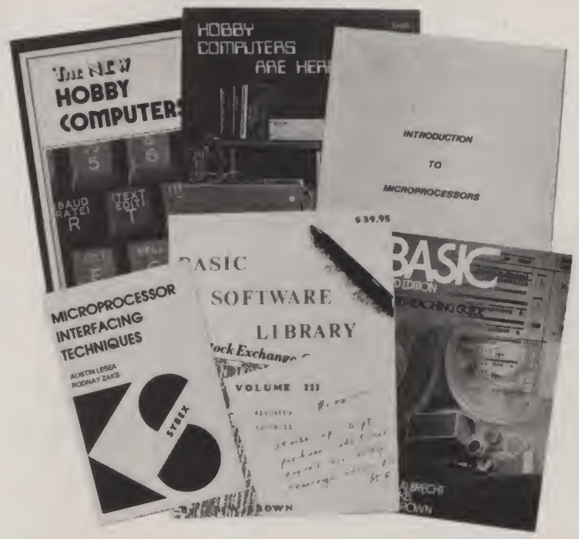

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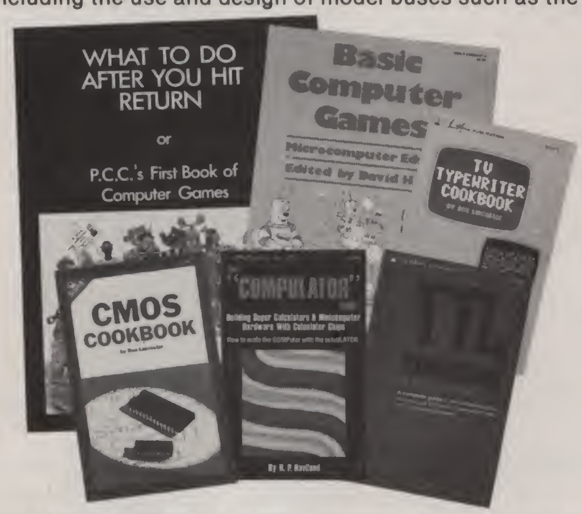

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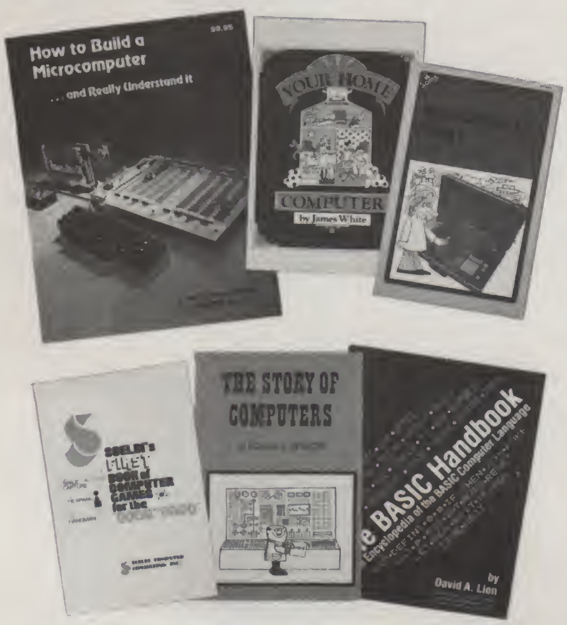

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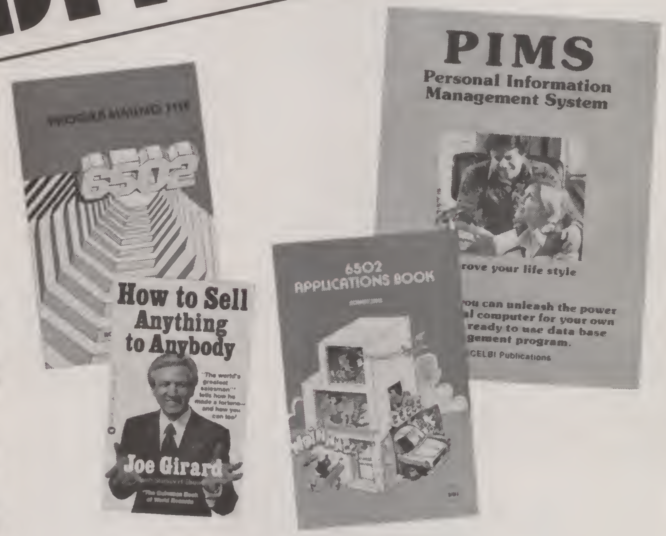

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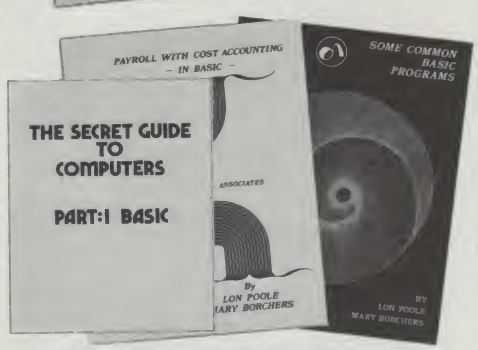

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